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Concrete Tower Enclosing a Water-Works Tank at Gary, Ind.

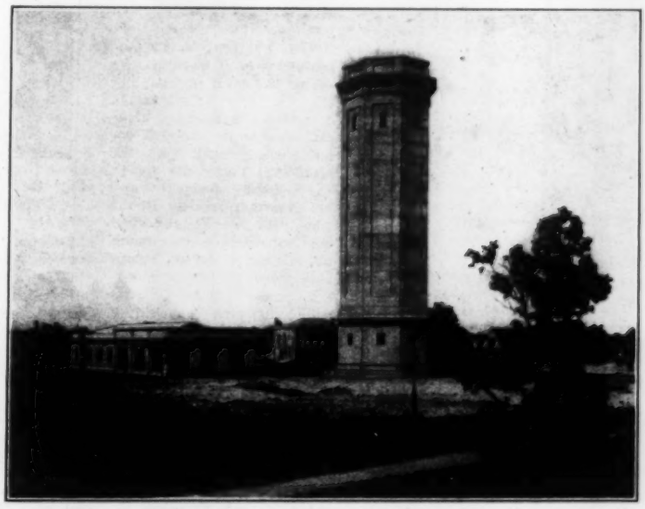
The water-supply of the "steel city" of Gary, Ind., is drawn from Lake Michigan by a 6-ft. brick-lined intake tunnel three miles long, extending from a submerged intake 1½ miles from the shore to a pumping station in the city. The pumping station and water tower are located in the public park which forms the center of the city, and it was desired, therefore, to have structures of attractive appearance. This was an easy matter in regard to the pumping station, but more difficult in regard to the tower. The plan adopted was to support the 300,000-gal. tank on a steel tower having vertical columns and to enclose this with a concrete tower of appropriate design. The tower is of exceptionally good appearance, and forms a handsome and conspicuous landmark, as will be seen by the accompanying view, which shows also the pumping station.*

The water-works plant is owned by the Gary Heat, Light & Water Co. The engineers for the design and construction of the entire plant are Alvord & Burdick, of Chicago. The architectural details for the tower and pumping station were worked out by Mr. Victor A. Matteson, of LaSalle, Ill. The general contract for the station was let to the Schmidt Brothers Co., of Chicago. The contract for the concrete tower was awarded to the George Rackle & Sons Co., of Cleveland, O., who also made the architectural concrete work for the pumping station. The steel tank and tower were built by the American Bridge Co.

REINFORCED-CONCRETE TOWER.—The tower is octagonal in plan, 34 ft. diameter inside the faces. It is 133 ft. high from the grade line. It is of monolithic construction, with architectural features of cast concrete blocks. This block work is applied as a 4-in. veneering to a height of about 29½ ft. above grade line, and is used also for the cornice and the balustrade which surmounts it. The tower is entirely independent of the steel structure which it encloses.

The foundation is a heavy octagonal slab of reinforced concrete, with a wall of the same form. On the interior of the wall are formed piers for the eight steel columns supporting the water tank. This slab is seated in the deep sand bed which forms the southern shore of Lake Michigan, and is designed to give a pressure not exceeding two tons per sq. ft. on the sand. The slab is 48 ft. diameter, from 24 to 36 ins. thick. It is very heavily reinforced by 176 horizontal bars and bent shear bars 1½ ins. diameter; which are arranged radially as shown in Fig. 2. The outer end of each bar is fitted with a heavy nut and washer as an anchor to compensate for the comparatively short length. The weight of these rods is about 17,982 lbs.

The walls of the tower are 19 and 14 ins. thick in the lower part, exclusive of the veneer; in the upper part the thickness is 12 ins., reduced to 8 ins. for the panels which relieve the surface. A section of the walls is shown in Fig. 2. The dome, Fig. 4, is 4 ins. thick at the center, but is reinforced by eight radial ribs extending to the corners. It has a top radius of 38½ ft. and a gutter is formed behind the cornice. The walls are reinforced mainly by a single row of vertical bars about 12 ins. apart, with horizontal rings outside of these bars and about 12 ins. apart. All these are square twisted bars. The reinforcement is required to be not less than 0.3% horizontally and the same amount vertically. The structure is designed to resist a wind pressure of 40 lbs. per sq. ft. of flat surface.



REINFORCED-CONCRETE WATER TOWER (ENCLOSING STEEL TOWER AND TANK) AT GARY, IND.
Alvord & Burdick, Chicago, Engineers.

The concrete was composed of Portland cement, clean sand and 1-in. broken stone in the proportions of 1:2:4. This was machine mixed, quite wet. It was handled in wheelbarrows, which were hoisted by an electric elevator and wheeled across the falsework to the desired point. The concrete was well stirred in the forms, and the stones were spaded back from the face. After completion, the exterior surface was given a sand float finish, the facing being of Portland cement and Ottawa silica sand, 1:1. This was applied with a wood float and thoroughly rubbed in, averaging ⅛-in. in thickness. The block work was of gravel concrete, 1:4. Each block had a facing of cement and white silica sand 1:2½, with an addition of 1½% of Medusa waterproofing. The concrete of the dome is not treated in any special manner for waterproofing.

The forms for the tower were from 5 to 8 ft. high, or as high as would permit of convenient and proper working of the concrete. They were braced on the outside by the timber tower forming the falsework. On the inside they were braced from the steel tower. The main part of the tower was built during October and November, 1909. The dome and finishing work were done in 1910, after the close of the winter.

STEEL TANK AND TOWER.—Various methods were considered for carrying the tank upon the walls of the concrete tower by means of brackets or a flaring skirt girder. The weight was too great to be disposed economically in this way, however, especially as the concrete tower had to have a sufficient clearance space around the tank. The steel tank and tower are shown in Fig. 3.

The steel tank is 30 ft. inside diameter, with a hemispherical bottom, and its total depth is 60 ft. It is built up in 5-ft. rings, the thickness ranging from ⅜-in. in the lower rings (and bottom) to ¼-in. in the upper rings. At the top and at intermediate points are outside stiffening rings of angles 4 × 6 ins. The columns are of H section, each composed of four angles 4 × 6 ins. and a 3/16-in. web plate 17 ins. wide. At the connection with the tank, the outer angles of the columns extend to the top of the second cylindrical ring (and bearing against the circular stiffening ring). Vertical filler angles in-

*A brick tower enclosing a steel stand-pipe at Oak Forest, Ill., was illustrated in our issue of March 24, 1910.

side the column angles are riveted to the shell plates. The inner angles of the column stop about 7 ft. below the bottom cylindrical ring and (with filler angles on the inside) bear against lugs riveted to the hemispherical shell. The columns are connected at the bottom and at intervals of about 20 ft. by horizontal struts, each composed of a pair of 8-in. channels with top and bottom lacing. The backs of the channels are riveted between bent connection plates which are riveted to the inner and outer faces of the columns. A 16-in. pipe enters the bottom of the tank.

PUMPING STATION.—This building is a one-story structure and includes an electric substation. In plan it is about 142½ × 62½ ft., with a roof carried by steel trusses. The walls are of concrete blocks, which were made at the site. Some of the blocks are of stone color and others are tinted brown; all of them have vertical chasing or tool finish on the face. The building is of handsome appearance, and is an excellent example of concrete block building construction. The concrete covering is almost entirely an extra expense above the total cost of an uncovered tank, but to any community desirous of artistic public structures this cost would seem to be justified.

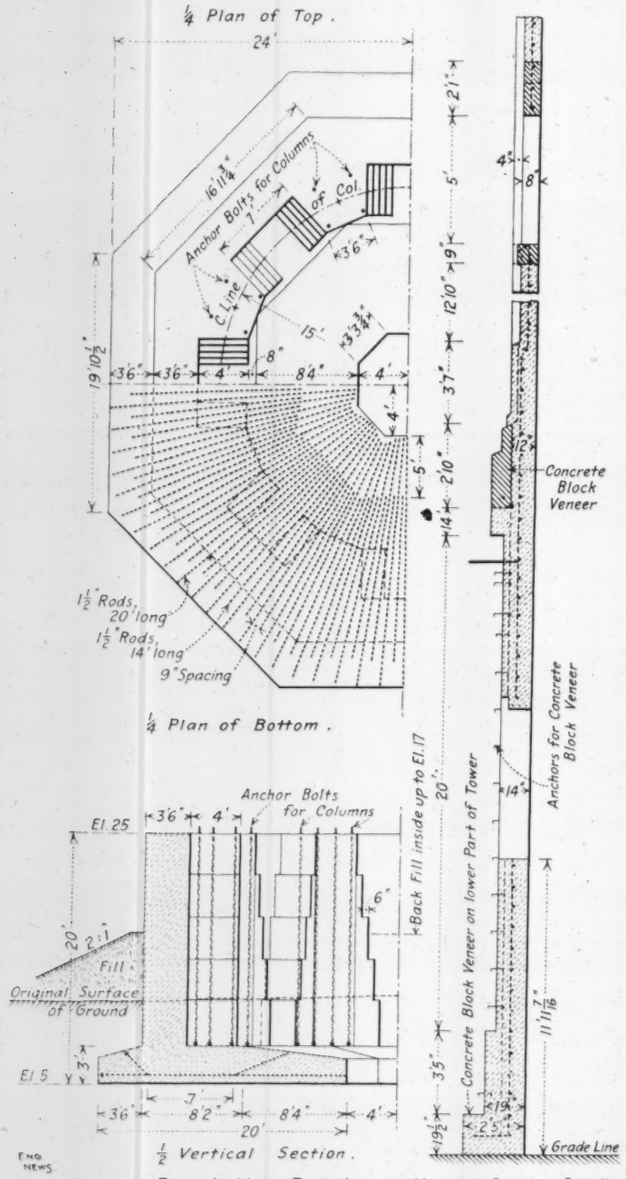


FIG. 2. FOUNDATION OF WATER TOWER AND SECTION OF REINFORCED-CONCRETE WALL.

Water Powers.*

By HERBERT KNOX SMITH.†

In our complex civilization there are many things that are necessaries of life. Control over any of them represents a power that is essentially governmental. This is plainly true of basic necessaries like food, clothing, transportation, heat and light; it is true of the natural resources that are back of these. It is also true of the mechanical power that produces and delivers them. Private control of any of these, unrestrained either by business competition or by governmental authority, means that irresponsible individuals hold a command over the daily life and welfare of the citizen which the men of our race have never willingly granted to any except their own representatives chosen by them.

For us, mechanical power is a basic necessary, and our power demand continually rises. Our chief present sources of power supply—coal, petroleum and natural gas—although at present ample, are absolutely fixed in quantity and cannot be replaced. Water-power is the one important source of mechanical power now practically available which is self-renewing. Its importance, therefore, to our present vision, must steadily increase.

We can no longer expect that business competition will impose any effective restraint upon the control of water powers. It will not. It is becoming daily more and more improbable. There has already been a marked concentration of water-power control in private hands, and this process is advancing rapidly. Public regulation of water power, the only alternative restraint, therefore becomes by so much a necessity.

Electric transmission has worked this change within the last decade. As now commercially practicable, such transmission allows a given water power to reach a market area of at least 80,000 sq. mi. It has raised water power from purely local work and made it the vital energy for great communities and distant enterprises. It has brought our water-power resources suddenly within the sweep of great economic forces.

What are these forces? Within these market areas just described, there are strong practical reasons for consolidation of water powers—what is known as "coupling up." A power plant must be constructed to meet the highest point of its expected demand—the "peak of the load." The nearer the "load" the power demand) approaches that peak for all the time, the more fully will the entire fixed investment be earning a return. Suppose there are two independent power plants in two neighboring communities where the demand in one community is mainly for power during the day time, and in the other at night. These plants can advantageously combine, throwing the surplus of their joint power by day to one place and by night to the other, thus bringing their normal load in each case up nearer to the peak. Similarly, such coupling up is obviously advantageous in two neighboring watersheds where the excess water power occurs at different times. In general such combining of varying conditions to produce a closer parallelism of supply and demand is in itself an entirely proper industrial development. We have no reason to oppose it if accomplished by fair methods; we must simply be prepared to regulate such monopolistic power as may result therefrom.

*An address delivered before the National Conservation Congress at St. Paul, Minn., Sept. 6, 1910.

†Commissioner of Corporations, U. S. Department of Commerce and Labor, Washington, D. C.

What has thus far resulted? The investigation of developed water powers now being made by the Corporations shows that up to date 18 concerns ... allied interests control over 1,800,000 HP. of power developed or in process of construction addition over 1,400,000 HP. of undeveloped wa... As to undeveloped powers, this information w... merely as an incident to our main work and ... much understates the case. As it stands, ... makes a total water power controlled by these ... of over 3,200,000 HP.

Here let me give a few comparative figures. ... water power in use in the United States in 19... timated by the Census and the Geological Sur... only 5,300,000. And this total includes a v... number of small powers which the Bureau did not ... as it dealt almost wholly with powers of over ... HP.

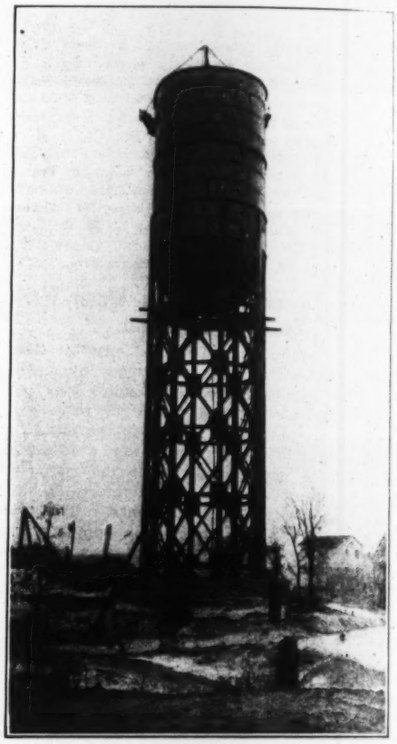


Fig. 3. Steel Water Tank (300,000 Galls.) and Tower With Vertical Columns; Gary, Ind.

The total now commercially capable of development is variously estimated at from 30,000,000 to 60,000,000 HP., the smaller figure being the preferable one. Our power demand as measured by the total unduplicated capacity of all prime movers—steam, water, and gas—is now at least 30,000,000 HP.

It is obvious, also, that a local monopoly of power covering simply one market area is nevertheless as complete in its effects on the inhabitants of that area as if it covered the entire country. Conditions in separate sections are therefore important.

In California, for example, four principal hydro-electric companies dominate the water-power industry. They have a total developed horsepower of 259,000, with probably 500,000 HP. additional undeveloped, and a very strong hold on the most important power markets. And between these four concerns there is also evidence of considerable harmony.

This is not a unique case. Conditions somewhat like this exist in the Puget Sound territory, in the Southern Peninsula of Michigan, in Colorado, in Montana and in the Carolinas. In each of these sections one or at most two great concerns are predominant in their control of water powers, public-service companies and power markets. The great bulk of both developed and undeveloped water power lies on the Pacific Coast, the Northwest, Northeast, and the South Atlantic States.

The horse-power figures, however, do not fully represent the extent of actual commercial control. The best powers have of course been developed first. These will always hold a disproportionately dominant position over later developed and less favored powers, because of their lower operating cost and prior hold on the important power markets.

The foregoing represents one phase of concentration. But there is also going on a concentration of a wider sort—a process of deep significance, but as yet little recognized. There is a marked progress toward a multi-

of interest among public-service companies generally electric light, power, gas, and street railway companies. The significant identity of officers and directors in a large number of such companies throughout the United States is very remarkable.

In part this is due to specialization by financial houses in given lines of investment; in part to the common employment of certain eminent engineering firms; and in part to relations with certain leading equipment companies. Electric equipment is usually supplied by one of a few great equipment concerns and frequently paid for, at least in part, in the securities of the proposed plant. Thus the equipment company acquires interests in widely separated power and light concerns.

Take a single example, the General Electric Co., which is the most powerful electric equipment concern in the world. Men who are officers or directors of the General Electric Co. or of its three wholly controlled subsidiary companies, are also officers or directors in many other corporations. These other companies, with their subsidiaries, and with the General Electric and its subsidiaries, make thus a group interconnected by active personal and financial relationship. Observe that I said "interconnected," not "merged." But the interconnection is of a substantial character. This one group includes 28 corporations that operate hydro-electric plants, with at least 795,000 HP. developed or under construction, and 600,000 undeveloped, in 16 different states, a total of 1,395,000 HP. (equal to more than 25% of all the developed water power in the United States in 1908). This group includes also over 80 public-service corporations, not counting their minor subsidiaries; more than 15 railroads; 6 companies that use their power in the manufacture of cotton goods, with 35,000 hydraulic horsepower developed; and over 30 banks and financial houses, many of them in the first rank of importance. This remarkable financial connection in itself is very significant. Fifty-three General Electric men, in all, constitute this chain of connection. Nor are these men, as a rule, of the figurehead type; their presence on a directorate means something. Of course these facts in no sense always mean identity of control. They certainly do mean a striking degree of nonconflicting interests and personal relationship which makes further concentration easily possible.

This wider concentration is still in a formative stage, developed almost wholly within the last decade. The forces compelling thereto are still operative. It is like a physical solution of chemical elements which is still in suspension but which a single jar may precipitate into crystallization. Water power, being naturally allied with public-service business, will be included in a movement that affects that business. So wide is this interrelationship, and so comparatively few are the constantly recurring names in the directorates, that a few brief conferences, given the necessary impetus, might conceivably at any moment concentrate into definite legal form a sweeping unified control over the dominant water powers of the country, as well as their related public-service interests.

Here, then, is the present situation of the hydro-electric industry:

(1) It deals with a basic necessary and its importance inevitably increases as the fixed supply of other sources of power decreases.

(2) Substantial control of mechanical power means the exercise of a function that is governmental in its effect on the public.

(3) Driven by underlying economic and financial forces, concentration of control of water powers in private hands has proceeded very rapidly. It is doubtful if anything can arrest this process, and a swift advance to a far higher degree of concentration is entirely possible.

(4) Any chance, then, of restraint by competition is rapidly disappearing, certainly over given sections, and public regulation is therefore an imminent necessity.

The extent of such regulation will depend mainly upon constitutional limitations. A state, roughly speaking, can at any time exercise a high degree of control over power companies as quasi-public servants.

The jurisdiction of the federal government covers a far wider range geographically, but involves some difficult constitutional questions. Over water powers on the public lands it has full control. I concede no merit to doubts as to the Government's unlimited jurisdiction there.

As to powers on navigable streams not in the public domain, there is an undetermined constitutional question. No dam can be maintained in a navigable stream without the consent of the federal government. Nearly every one admits that the government may impose upon such grants any desired time limitation, and may thus require readjustment of terms at any desired period.

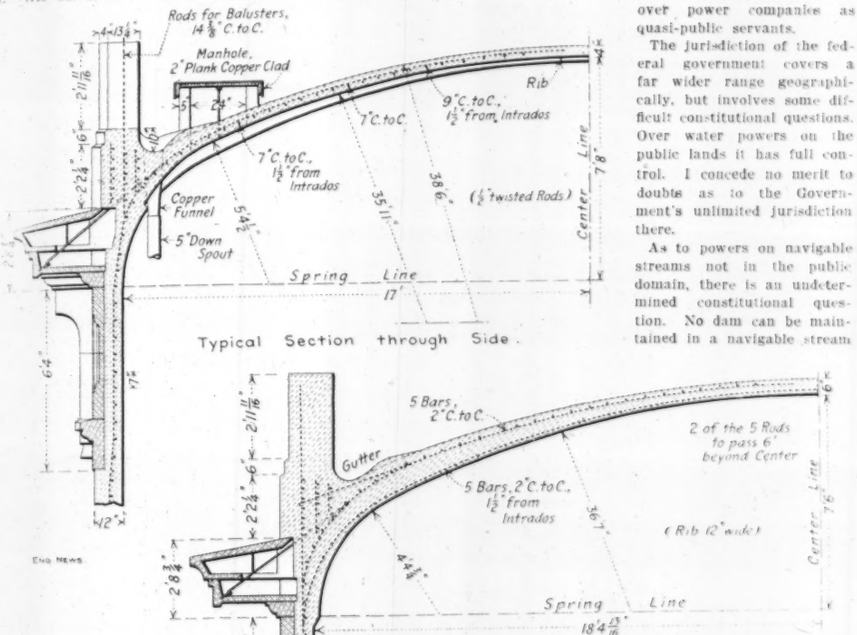

Rods for Balusters, 14⅜" C. to C.
Manhole, 2" Plank Copper Clad
Rib
9" C. to C., 1½" from Intrados
7" C. to C.
7" C. to C., 1½" from Intrados
Copper Funnel
5" Down Spout
Spring Line
Center Line
(½" twisted Rods)
Typical Section through Side.
5 Bars, 2" C. to C.
2 of the 5 Rods to pass 6" beyond Center
Gutter
5 Bars, 2" C. to C., 1½" from Intrados
Rib 12" wide
Spring Line
Section through Center of Square Rib.

FIG. 4. DOME OF REINFORCED-CONCRETE WATER TOWER.

But some hold that the federal government, in exercising its arbitrary power as grantor, may also impose any further conditions it chooses upon such grant, as, for example, that the grantees shall pay a rental for the water power acquired. Others hold that the federal government can only impose such conditions as are directly connected with the federal power over interstate commerce, such as navigation. Even this view would apparently at least permit a rental charge, if applied to navigation improvement. Personally, I am strongly inclined to the former and broader view that any conditions whatsoever may be imposed, both on general principles and on well-established legislative precedents. In numerous bridge and dam acts Congress has used the broad power and imposed conditions in no way related to interstate commerce. In the California Debris Commission Act, operative since 1893, Congress imposed a straight charge on placer miners for the privilege of emptying their refuse into the streams.

The scope of the federal jurisdiction is of first importance, because the water-power problem is, in the main, a national one. Much of the power is transmitted across state lines or is used by interstate carriers, the bulk of the capital that is developing our most important powers comes from interests outside the states where the powers are located, and from the brief survey I have already given of the concentration of water powers and of the interrelationships existing between public service companies it is obvious that state lines and state jurisdiction have no practical relation whatsoever to the sweep of these forces. The hydro-electric business has been largely nationalized by those who are foremost in it. They at least cannot now be heard to object to such national action as is adapted to meet the business conditions that they themselves have created.

Undoubtedly there are local forces and conditions which the state must handle. The nation and the state should therefore cooperate. But this does not mean that the nation should abdicate any of its powers. The nation and the state will both have to use their full powers to meet the water-power situation. The most effective time to use them is before, not after, private rights accrue. The one certain method is for the state or the federal government to retain its interest, or impose its conditions, at the inception, as a part of the grant. Then public control and private rights go together, as they must if we are to safeguard the public interest in water power.

Let there be no unnecessary hampering of hydro-electric development. There need be none. But let the public be in on the ground floor at the start, for at the start the public must grant the power and for all time the public will be the party chiefly interested in its use.

Specifically:

(1) The status quo of powers still controlled by the nation or state should be maintained until we know what we have, and can act intelligently thereon.

(2) No grant should be made except for a fixed period, with at least the reserved right to readjust terms at the end thereof. That period, however, should be long enough to permit adequate financing and complete development.

(3) Complete publicity of accounts and transactions should be required as well as a record of cost, and the real relation of investment to stock and bond issues. They are public-service companies and the public has a right to the information.

(4) Power to revoke the grant for breach of conditions should be lodged in a specified public authority. Otherwise there will always be the possibility of protracted litigation to determine the status.

(5) So far as is possible, direct provision should be made against excessive charges and monopolistic abuse.

(6) Public authorities should reserve such constitutional compensation or rental as will establish the principle of underlying public interest.

(7) All public easements of navigation, fisheries, etc., should be safeguarded.

(8) In the case of new grants, all these provisions should be made conditions of the grant.

Finally, the purpose and probable effect on the public of any grant should first be fully ascertained and carefully considered, in order to determine whether public interest justifies beyond a reasonable doubt the surrender by the public of even a part of its power over this great public resource. So long as such reasonable doubt exists, the surrender should not be made.

SINGLE-PHASE FREIGHT RAILWAY IN SWEDEN.—It has been announced that the Swedish Reichstag has accepted a proposition from the Siemens-Schuckertwerke, of Berlin, Germany, for the construction of a power plant at Porjus Falls and for the electrification of an interurban railway line between Kiruna and Riksgraensen in the west of Sweden. The total amount involved in the contract is $1,000,000. The main transportation, over the line to be electrified, is of iron ore to the Norwegian frontier. One train will have a total weight of something over 2,000 tons, and will be hauled by two locomotive units, each having two motors of 1,000 HP. continuous-capacity rating. It is claimed that these freight locomotives will be the largest ever constructed. Passenger service is also to be carried by express trains to run at 100 kilos. (62 miles) per hr. and hauled by locomotive units having but one motor to 1,000 HP. The power station will be equipped with three 10,000-KVA., 15-cycle, single-phase generators. Current will be transmitted at a voltage of 80,000 to four substations along the line where the voltage will be stepped down to 15,000 for supply to the railway overhead lines.

THE OHIO STATE CANALS have an aggregate length of 642 miles, supported by reservoirs with a combined area of 30,050 acres. The earnings were $138,238 during 1909, being the largest for ten years. The most important lines are the two canals connecting Lake Erie with the Ohio River: (1) the Ohio Canal, from Cleveland to Portsmouth, 308 miles; and (2) the Miami & Erie Canal, from Cincinnati to Toledo, 244 miles. The system originally aggregated 814 miles, but about 172 miles have been abandoned. Improvements projected and partly carried out include dredging the channel and rebuilding locks and other structures. The improvement of the northern division of the Ohio Canal, from Cleveland to Dresden (to connect with the Muskingum River, as improved by the government), is estimated to cost $1,031,600, and requires $243,600 for its completion. For the rehabilitation of the Miami & Erie Canal, the estimate was $2,080,685, and for the completion of this work $1,294,684 is required. The canals are administered by a State Board of Public Works, of which Mr. Charles E. Perkins, M. Am. Soc. C. E., was Chief Engineer for several years. He resigned early in 1910, and the present Chief Engineer of the Works is Mr. James R. Marker. The only work in hand at present is some dredging and the construction of one new lock. The last legislature failed to make the necessary appropriation for carrying out the scheme of improvements, and appropriated only $60,000 for this season.

Excavation of Wallkill Pressure Tunnel, Catskill Aqueduct (New York City Water Supply).

By C. RAYMOND HULSART.*

The Catskill Aqueduct, which will deliver 500 million gallons of water per day to New York City from the 130 billion gallon Ashokan Reservoir in the southern part of the Catskill Mountains, will be 92 miles long from the headworks at the reservoir to the equalizing reservoir at Hill View, about two miles southeast of Yonkers and one-half mile north of the New York City line. From the Hill View Reservoir the City Aqueduct, a pressure tunnel in rock 18 miles long, will carry the aqueduct south through Bronx Borough to and under the Harlem River to Manhattan and Brooklyn. The work is being done by the Board of Water Supply, City of New York. Mr. J. Waldo Smith is Chief Engineer for the Board.

*Assistant Engineer, Board of Water Supply, New York City; field address, New Paltz, N. Y.

The Catskill Aqueduct is built to four general types (Fig. 2), two of which apply to aqueduct on the hydraulic gradient and two apply to aqueduct under pressure (inverted siphon). The former are: Cut-and-Cover, where the topography calls for open-cut or embankment work; and, Grade Tunnel, where the topography offers obstacles which must be tunneled. The types applied to inverted siphons, to operate under hydraulic pressure are: Pressure Tunnel, and Steel Pipe. The three first types are built with one waterway. Steel pipe siphon will be built as three pipes to carry the total flow of the aqueduct. In the 92 miles of aqueduct from Ashokan Reservoir to Hill View Reservoir there are seven pressure tunnels, varying in length from 780 ft. to 4.8 miles, aggregating 17 miles; 24 grade tunnels varying from a few hundred feet to 2¼ miles and aggregating 14 miles; 14 steel pipe siphons 600 ft. to 6,700 ft. each, aggregating 6 miles; and intervening portions of cut-and-cover up to 15 miles long, aggregating 55 miles.

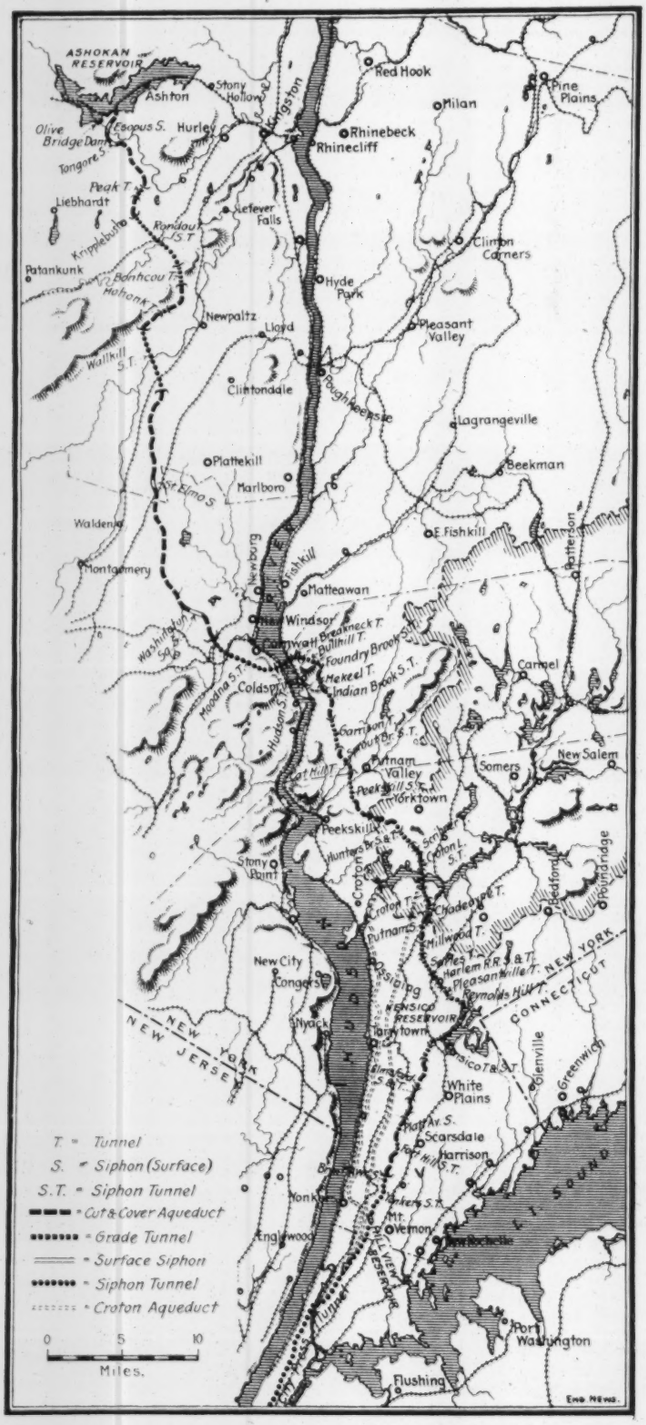


FIG. 1. MAP OF THE CATSKILL WATER-SUPPLY SYSTEM, NEW YORK CITY.
(Under construction.)

The pressure tunnels are the Rondout, Wallkill, Moodna, Hudson-Breakneck, Croton Lake, and Yonkers. These pressure tunnels are built entirely in rock, with vertical shafts. Some of the shafts are permanent waterway shafts connecting the tunnel with the adjacent cut-and-cover, or permanent drainage shafts for future unwatering for inspection or necessary repairs, while some are but temporary construction shafts which will later be sealed off and plugged with concrete.

Location Summary.

From the headworks of the Ashokan Reservoir the aqueduct passes in cut-and-cover, two steel-pipe siphons and a short grade tunnel, nine miles south to the downtake shaft of the Rondout pressure tunnel. The Rondout pressure tunnel is of 14 ft. 6 ins. diameter inside of concrete lining and 4.5 miles long, crossing under the Rondout valley and creek near High Falls, N. Y. Access to this tunnel is through eight shafts, 380 ft. to 710 ft. deep. Nine rock formations are encountered. The uptake shaft of the Rondout siphon is on the north side of the Shawangunk Mountains, and from here the aqueduct immediately passes through these mountains in the Bonticou tunnel, thence in cut-and-cover and a short tunnel along the east side of the Shawangunk Mountains to the downtake shaft of the Wallkill pressure tunnel. The Wallkill tunnel, 6 ins. diameter, extends 4.4 miles southerly under the Wallkill valley and river at an average depth of 350 ft. in Hudson River shale. From the uptake shaft the aqueduct continues in short stretches of cut-and-cover, broken only by a short depressed section of reinforced concrete aqueduct, the St. Elmo siphon, and the Washington Square steel-pipe siphon, 17 miles long, to the downtake shaft of the Moodna pressure tunnel.

The Moodna Tunnel is 14 ft. 2 ins. inside diameter and 4.8 miles long, passing through slate and granite. The tunnel is reached by seven shafts, 330 ft. to 580 ft. deep. From the downtake shaft it passes southeast under the valley of Moodna Creek, Cornwall, and the north side of Storm King Mountain to the west side of the Hudson River. Here the Moodna tunnel joins the downtake shaft of the Hudson pressure tunnel 230 ft. below the river and drops nearly 1,000 ft. to pass under the prehistoric Hudson River gorge 3,000 ft. horizontally to the uptake shaft on the east side of the river at the foot of Breakneck Mountain. At the uptake the waterway comes only to within 190 ft. of the surface of the river and then enters the Breakneck pressure tunnel continuing 780 ft. to the foot of Breakneck uptake shaft, 600 ft. deep. The aqueduct passes immediately into the Breakneck Mountain grade tunnel, followed by cut-and-cover, seven grade tunnels, including the 2¼ mile Garrison tunnel, and 6 steel-pipe siphons, a total distance of 21 miles to the downtake shaft of the Croton Lake pressure tunnel.

The Croton Lake tunnel, inside diameter 14 ft., passes under Croton Lake in Manhattan schist, a length of 2,640 ft.. There are but two shafts, the downtake and the uptake, 540 and 510 ft. deep respectively. In connection with the downtake there is a blowoff chamber fitted with valves, etc., and a blowoff tunnel and conduits to the lake, leaving the downtake about 100 ft. below its top. From the uptake shaft of the Croton tunnel, the aqueduct continues through successive sections of cut-and-cover, 7 grade tunnels, one steel-pipe siphon and one short pressure aqueduct, 9.5 miles to the influent works of the Kensico Distributing Reservoir, a reservoir of 40 billion gallons capacity.

From the effluent works of the Kensico Reservoir, the aqueduct continues through cut and-cover, six grade tunnels, 4 pipe siphons and one short pressure aqueduct, 12 miles to the Yonkers pressure tunnel. The Yonkers Tunnel is 16 ft. 7 ins. in inside diameter and is 2.3 miles long, penetrating hard gneiss. It is reached by an open portal at its north end and by four shafts from 110 to 150 ft. deep. At the north portal the tunnel separates into three 10-ft branches with a connection chamber and steel interlining, for connecting with the Bryn Mawr steel-pipe siphon. The uptake shaft is at the Hill View Reservoir. From the Hill View Reservoir, it is proposed to continue the City Aqueduct as pressure tunnel 18 miles, under Manhattan and the East River to Brooklyn.

The city pressure tunnel is reached by 24 shafts from 200 to 600 ft. deep, all but one of which are permanent shafts for distribution purposes. The inside finished diameter of the tunnel successively reduces from 15 ft. to 11 ft. as the flow decreases, to the uptake shaft at Lafayette Avenue in Brooklyn, from which point steel-pipe extensions enter Queens Borough and pass under the Narrows to Staten Island.

The Pressure Tunnels.

The pressure tunnel type of construction was adopted (where geological conditions were favorable) in preference to steel-pipe siphon construction, being more permanent and being considered also cheaper when repairs, renewals and maintenance are considered. Although the pressure tunnels are several hundred feet below the hydraulic gradient, the design of the concrete lining was governed by the external groundwater pressures rather than by the outward pressure from

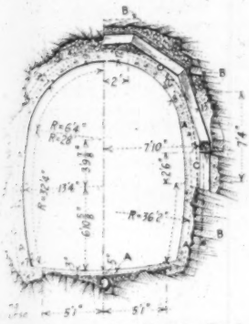


Fig. 2a. Grade Tunnel in Rock.

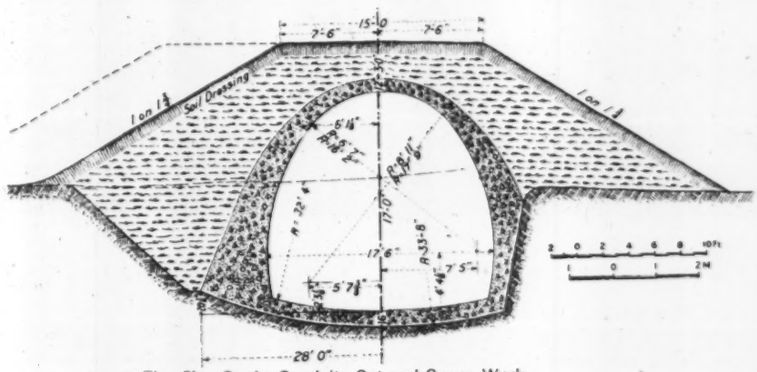


Fig. 2b. Grade Conduit Cut-and-Cover Work.

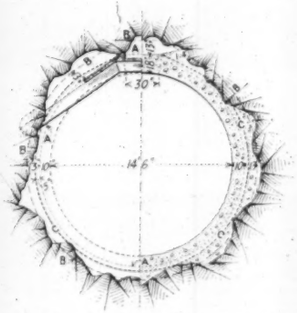


Fig. 2c. Pressure Tunnel in Rock.

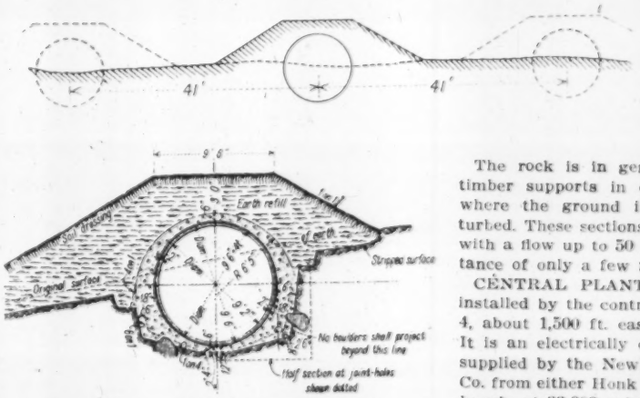


Fig. 2d. Pressure Conduit, Steel Pipe in Cut-and-Cover.

FIG. 2. TYPICAL SECTIONS OF CATSKILL AQUEDUCT.

water flowing through. The groundwater head to be sustained when the tunnel is empty is rarely less than 300 ft. and in the Rondout tunnel reaches 700 ft., whereas the internal pressure will never be due to a head of more than 300 to 400 ft. above the natural groundwater surface.

The amount of this groundwater pressure dictated the circular cross-section shown in Fig. 2c. The sizes of the several pressure tunnels, 14 ft. to 16 ft. 7 ins. finished diameter, were determined from economic studies of the distribution of the total available head and hydraulic slope for the various types of aqueduct.

The lining will be of concrete. All voids back of the lining, fissures and seams in the rock will be filled with cement grout, introduced under sufficient pressure to overcome the groundwater head. Where the ground is such that timber cannot be removed before lining, permanent steel supports will be used, as it is not considered desirable to leave anything perishable like timber between the concrete lining and the rock walls of the tunnels.

An important consideration in the design of the pressure tunnels is that of unwatering for repairs and inspection. For this purpose three types of drainage shaft were adopted, depending on length of tunnel and conditions influencing location of shafts. When the siphon is of sufficient length for construction shafts between the waterway shafts, as in the Rondout and Wallkill, one of these shafts is offset from the tunnel and connected to it by a drift which is provided with an effective seal, so that the shaft may be used for drainage purposes. Where there are but the two waterway shafts as in the Croton tunnel, a waterway shaft is changed in design and utilized for drainage. Where a step exists in the waterway, and that part of the shaft above the step is needed for construction as in the Hudson pressure tunnel, this shaft is utilized. The Moodna and Breakneck tunnels drain into the Hudson pressure tunnel. The Yonkers tunnel drains from its north portal into the Bryn Mawr steel pipe siphon, which is provided with a blowoff.

The lines marked A and C in Figs. 2, 4 and 7 determine the minimum section to be excavated or the thickness of tunnel lining. The A-line is the line within which no unexcavated material of any kind may remain. It determines the minimum thickness of masonry lining. The C-line is the line of effective average thickness of masonry lining. Except for points or limited areas, the C-line is the trimming line. The B-line is a payment line for excavation and lining whatever the area of section actually excavated.

The Wallkill Tunnel.

The Wallkill Pressure Tunnel, the excavation of which is now nearly completed, is shown in profile in Fig. 3. The work is being executed by the Degnon Contracting Co., of New York City. The tunnel is 23,391 ft. long. It is reached through six shafts, 350 to 480 ft. deep, the last of which was completed January, 1910. Shafts 1 and 6 are permanent waterway shafts and are already lined (Figs. 4 and 5). Shaft 3 is a circular permanent drainage shaft. It is offset 75 ft. from the tunnel center line, and is connected to it by a drift which will later be lined and sealed with a heavy bronze door. A system of floating pumps with discharge pipes, valves, etc., will be installed at this shaft. Shafts 2, 4 and 5 are temporary construction shafts, and will be sealed and plugged with concrete.

The rock penetrated by shafts and tunnel is Hudson River shale, a rock of the Lower Silurian period. It is composed generally of alternate layers of slate and sandstone from one inch to one foot thick, the slate predominating. In general the strata dip about 45° to the southeast and strike at an angle of about 30° to the tunnel center line. The slate is the heavier rock, with a specific gravity of 2.74, weighing 171 lbs. per sq. ft. It is much the easier-drilling rock however. The sandstone is much harder, but lighter; specific gravity 2.67, weight 167 lbs. per cu. ft. Much drilling trouble is caused by the sandstone, on account of its dip and strike, in drilling from slate into sandstone, the steel almost invariably running off and blocking.

The rock is in general very sound, requiring timber supports in only a few short stretches where the ground is much distorted and disturbed. These sections were usually waterbearing, with a flow up to 50 gallons per minute in a distance of only a few feet.

CENTRAL PLANT.—The central power-plant installed by the contractor is situated near Shaft 4, about 1,500 ft. east of the tunnel center line. It is an electrically operated plant, power being supplied by the Newburgh Light, Heat & Power Co. from either Honk Falls, Poughkeepsie or Newburgh, at 33,000 volts. The voltage is reduced at the plant to 2,200 volts for operating compressors and for transmission to the shafts.

The total compressor capacity is 11,900 cu. ft. of free air per minute to a pressure of 100 lbs. per sq. in. There are five cross-compound compressors: two Laidlaw-Dunn-Gordon, 2,520 cu. ft. each, 29 and 18 ins. by 30 ins. stroke; two Ingersoll-Rand, 2,600 cu. ft. each, 28 and 17 ins. by 24 ins. stroke; and one Ingersoll-Rand, 1,660 cu. ft., 25 and 15 ins. by 20 ins. stroke.

The four larger compressors are each driven by a 500-H.P. General Electric induction motor, and the smaller compressor by a 300-HP. motor, working on 2,200-volt three-phase alternating current.

The capacity provided has been found ample, as upon occasion of greatest draft, with active tunnel operations proceeding at ten working faces and the pumps delivering 153,000 ft.-gals. per min. there was always one large compressor idle. It is usually necessary to run three large compressors and the smaller one while drilling is in progress and but two large ones at other times to supply air for pumps and leakage in mains.

The total power consumption for all purposes, metered at the central plant in July when all headings were working, is as follows:

	Compressors.	Hoists.	Lights, blowers, elec. locos., & elec. pumps.	Total.
KW.-hrs. per day.....	25,300	2,780	1,570	29,650
KW.-hrs. per cu. yd. excav.	30.2	3.3	1.9	35.4

The power expended in compressing air, a total

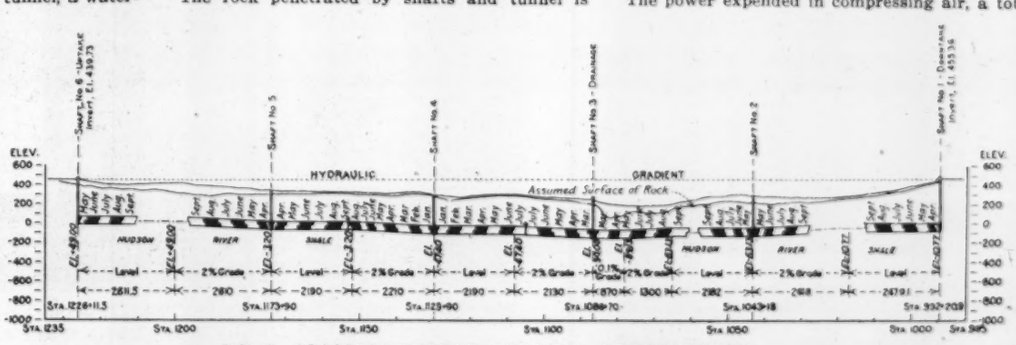


FIG. 3. PROGRESS PROFILE, WALLKILL SIPHON TUNNEL.

of 10,120,000 cu. ft. free air in 24 hrs., is 2.5 KW-hrs. per 1,000 cu. ft. of free air compressed to 100 lbs.

The distribution of the compressed air follows:

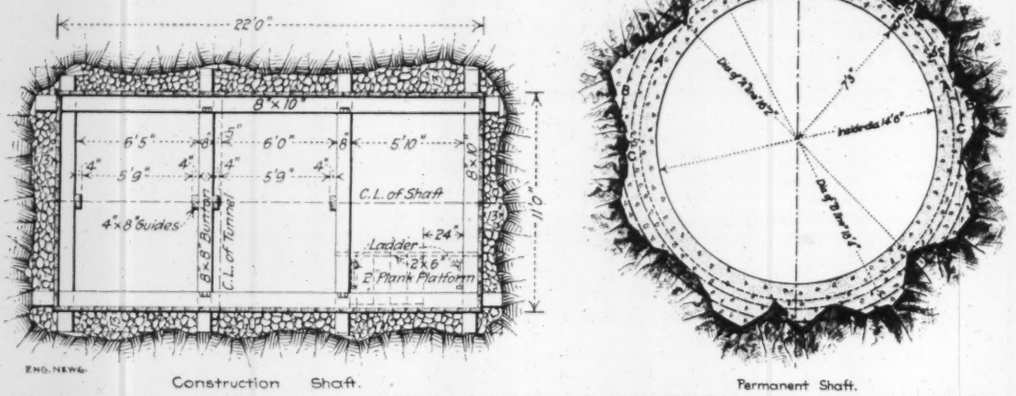


FIG. 4. TYPICAL SECTIONS OF CONSTRUCTION SHAFTS AND PERMANENT SHAFTS, WALLKILL SIPHON TUNNEL.

CONSUMPTION OF COMPRESSED AIR.
(In terms of cu. ft. free air.)

	Drills.*	Pumps.	Leakage in mains and other losses.	Total.
Per day	5,545,000	3,855,000	720,000	10,120,000
Per yd. of excav.	6,600	4,600	800	12,000

*Includes escaping air in heading for blowing smoke.

Tests show the amount compressed for one drill including proportion of leakage and losses to be:

Per shift (4½ hrs. drilling)	25,900 cu. ft. free air
Per min., including stops	96 cu. ft. free air
Per min., while actually hitting rock	166 cu. ft. free air

The amount of air compressed for pumps, including a proportion of the leakage, totaled 4,155,000 cu. ft. free air, and pumped 220 million ft.-gals. per day or 18,800 cu. ft. free air per million foot-gallons.

Air is delivered to the shafts through 25,000 ft. of mains, reducing in size from 12 ins. at the plant to 6 ins. at Shaft 1 and 5 ins. at Shaft 6. While drilling is in progress in all headings the pressure falls to 95 lbs. at Shaft 4 nearest the plant, 80 lbs. at Shaft 1, and 85 lbs. at Shaft 6.

Power lines carrying 2,200 volts from the plant supply current to each shaft for operating hoists, which is transformed to 220 volts at the shafts for operating ventilating blowers, electric pumps, electric locomotives and lamps.

SHAFT PLANT.—The Lambert hoist is operated by a Westinghouse 150-HP. three-phase 2,200-volt motor. The hoist drum is 5½ ft. in diameter with 1⅛-in. Hazzard steel cable supporting balanced cages of 4 tons muck capacity. The hoist is capable of a speed of 500 ft. per min., but is ordinarily operated at about 400 ft. per min. The hoists are equipped with solenoid brakes which set automatically if power is cut off. There are also automatic switches on the headframe to prevent overwinding, by throwing a circuit-breaker in the hoist house if the cages are raised above a safe point. The cages are equipped with safety dogs which automatically grip the timber guides when the strain on the cable is released. Tests under working conditions have shown the safety dogs to be efficient.

MUCKING PLANT.—Tunnel muck is handled in Koppel 1½-yd. steel side-dumping cars of 30-in. gage; about 12 cars at each shaft. Single track of 25-lb. rails is laid in each tunnel, with turnouts and extra spur at the face of the bench. Hauling in the tunnels or on the dump is, as a rule, by mules. Two Baldwin electric locomotives operated by 11-HP. Westinghouse motors have been in use and have given excellent satisfaction, one in the tunnels at Shaft 4 and later on the dump at Shaft 2, and the other on the dump at Shaft 5. They are operated by direct current supplied by a motor-generator set in the hoist house. They have proved economical in operation, the one in the tunnels using 0.67 KW.-hr. per cu. yd. rock per 1,000 ft. lead, or 0.46 KW.-hr. per ton-mile, and the one on the dump using 0.45 KW.-hr. per cu. yd per 1,000 ft. lead or 0.39 KW-hr. per ton-mile.

VENTILATION.—Electrically driven Sturtevant centrifugal blowers at each shaft are provided for ventilation. The blowers at the two heading shafts have a capacity of 7,500 cu. ft. free air per minute at 6½ oz., the air being led into the tunnels through 12-in. galvanized-iron pipes whose open end is kept within 300 or 400 ft. of the heading. Blowers are so arranged that air can be blown in or drawn out of the heading, although the latter procedure is apt to collapse the ventilator pipes and is little used. These blowers, working about 12 hours in 24 keep the air very clean and fresh. By blowing compressed air into the heading while blasting and for a short time afterward in conjunction with the blowers practically all smoke trouble is eliminated.

The tunnels are well lighted with one 16-c. p. lamp every 25 ft. and about 12 extra at the working faces.

PUMPING.—The pumps used were of sizes from 100 to 200 gals. per min., and were of two types: National steam pumps, operated by compressed air, and electrically driven Worthington three-stage turbine pumps. Practically all the pumping has been done with the air-driven pumps, the electric pumps being reserved for emergency and operated only for short periods only. There are at present six 200-gal. and [illegible] gal. National pumps and [illegible] gal. and two 200-gal. turbine [illegible]. The flow of water at present [illegible] gals. per min. from all tunnels [illegible] is pumped under an average [illegible] of 377 ft. The air consumption has already been stated.

Wallkill Tunnel Excavation.

DRILLING PLANT.—The drilling plant in each tunnel consists of two 5½-in. × 7 ft. [illegible] columns, each with one 4-in. and one 36-in. arm, and six 3¼-in. Ingersoll-Rand or Sullivan drills, four mounted on the columns in the heading and two on tripods on the bench. Small hammer drills are used for the necessary trimming holes. The air is delivered in 4-in. iron pipe to the top of the bench, where a manifold and 1-in. hose supplies the drills.

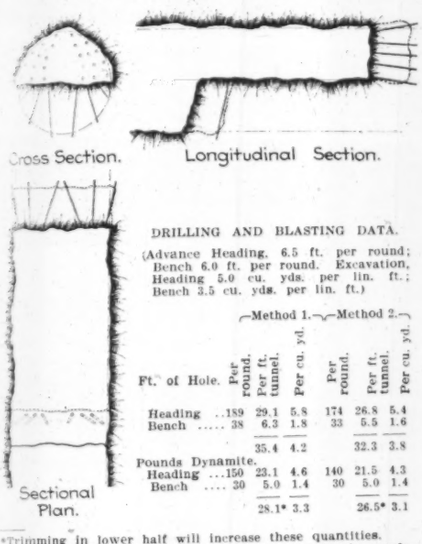
TUNNEL FORCE.

One Shift.	Number of shifts.	Total for 24 hrs. Men.	Animals.
1 superintendent	}	2	..
1 night superintendent	}		
1 master mechanic	1 (serves 2 shifts)	1	..
1 hoist runner	3	3	..
1 blacksmith	3	3	..
1 blacksmith helper	3	3	..
1 mechanic	2	2	..
2 pipemen	3	6	..
1 carpenter	1	1	..
2 electricians (day shift)	1	2	..
1 electrician (night shift)	2	2	..
2 signalmen	3	6	..
2 cagemen	3	6	..
2 heading foremen	2	4	..
12 drillers	2	24	..
12 drillers' helpers	2	24	..
2 jap drillers	1	2	..
2 nippers	2	4	..
2 waterboys	2	4	..
1 powderman	2	2	..
2 muckbosses	3	6	..
40 muckers	3	120	..
2 trackmen	3	6	..
1 trolleyman	3	3	..
1 dumpboss	3	3	..
3 dumpmen	3	9	..
4 drivers	3	12	..
4 mules	2	..	8
Total		260	8

FIG. 5. VIEW DOWN ONE OF THE PERMANENT SHAFTS OF THE WALLKILL SIPHON TUNNEL, CATSKILL AQUEDUCT DURING CONSTRUCTION.

The general method of tunnel excavation is the ...-heading and bench method, about 5 cu. yds. ... ft. being taken out in the heading and about ... cu. yds. in the bench, with about ½ cu. yd. ... trimming still to be done in the lower half of ... tunnel. The heading is usually carried about ... ft. ahead of the bench.

...rilling is carried on at both heading and bench ...ing two 8-hr. shifts, with 4-hr. interval be-



DRILLING AND BLASTING DATA.

(Advance Heading, 6.5 ft. per round; Bench 6.0 ft. per round. Excavation, Heading 5.0 cu. yds. per lin. ft.; Bench 3.5 cu. yds. per lin. ft.)

		Method 1.			Method 2.		
Ft. of Hole.		Per round.	Per ft. tunnel.	Per cu. yd.	Per round.	Per ft. tunnel.	Per cu. yd.
Heading	189	29.1	5.8		174	26.8	5.4
Bench	38	6.3	1.8		33	5.5	1.6
		35.4	4.2			32.3	3.8
Pounds Dynamite.							
Heading	150	23.1	4.6		140	21.5	4.3
Bench	30	5.0	1.4		30	5.0	1.4
		28.1*	3.3			26.5*	3.1

*Trimming in lower half will increase these quantities.

NOTE: One bench round shot with cut; extra bench rounds are shot separately before blasting heading.

In part of the tunnel a modified arrangement of holes, Method 2, was used, with 22 holes instead of 24 in the heading and 4 holes instead of 6 in the bench.

Loading of Holes, 60% Forcite, 0.8-lb. per stick. Cut, 10 to 16 sticks each; other heading holes, 4 to 8 sticks each; bench holes, 3 to 12 sticks each. Method 1: Total Heading, 175 to 200 sticks. Total Bench, 35 to 45 sticks. Method 2 Total Heading, 160 to 190 sticks. Total Bench, 30 to 40 sticks.

Fig. 6. Wallkill Siphon Tunnel: Arrangement of Drill-Holes.

tween drilling shifts for mucking out the heading sufficiently to set up the columns. Mucking is done by three gangs of eight hours each, representing about 19 hours actual mucking on account of time lost by shooting, etc. The full force at a two heading shift under normal conditions is as given by the table [on the preceding page].

DRILLING METHOD AND DETAILS.—Two methods of drilling were used; Method 1 (Fig. 6), with 24 holes in the heading and 6 on the bench, and Method 2 with 22 holes in the heading and 4 on the bench. Method 1 resulted in slightly better breakage on account of the extra holes. In both methods six drills were used, four on columns in the heading and two on tripods on the bench. The columns were set up about 3½ ft. either side of the tunnel center line and about as far from the face of the heading. The top dry holes and breaking-down holes were drilled with the top machines between the columns, all other holes with machines outside of the columns.

Black Diamond octagonal 1¼-in. and 1⅜-in. drill-steel was used, in lengths increasing by 2 ft. up to 10 ft. for the cut and to 8 ft. for the side rounds. The gage was reduced from 2¾ ins. on starter to 1¾ ins. on the 10-ft. lengths. The depths actually drilled per round and per yard of excavation are given in the tables attached to Fig. 6. The advance per round averaged under normal conditions 6.5 ft. for the heading and 6 ft. for the bench, two extra rounds being shot off the bench during the week.

Although more than half of the tunnel cross-section is shot with the heading, only about the length of the columns (7½ ft.) is mucked below the C-line for setting up, about 1½ ft. more being mucked out later.

The drilling shift of eight hours is occupied about as follows:

	Hrs.	Mins.
Setting up columns and drills	1	45
Actually drilling	4	30
Taking down columns and drills	.	15
Loading	.	30
Shooting	.	45
Remaining time off	.	15
	8	..

The time given above as expended in actually drilling would apply only under normal conditions of rock and air. When the ground is particularly hard or blocky, as is often the case when there is a large proportion of sandstone, the time of drilling runs as high as 15 or 20 hours, requiring at times as much as twenty hours on one hole. The total length drilled per shift as given in the table (Fig. 6) is 189 ft. or 10.5 ft. per drill per hour including changes of steel. Time to drill a 9-ft. cut hole is 50 to 55 mins. The speed of drilling while actually hitting the rock is of course much higher, being for the normal ground 4 mins. per ft. for dry holes, 3 mins. per ft. for wet holes and 5 mins. per ft. for down holes.

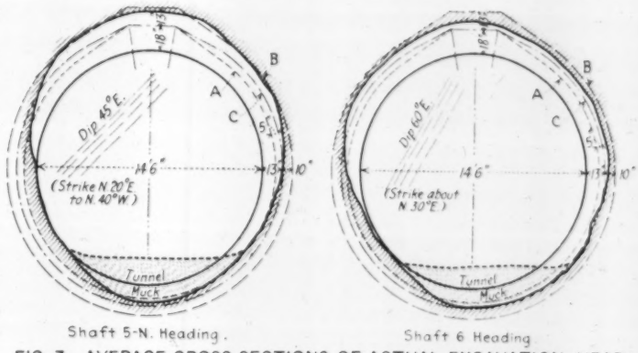


FIG. 7. AVERAGE CROSS-SECTIONS OF ACTUAL EXCAVATION, HEADINGS 5N. AND 6, WALLKILL SIPHON TUNNEL.

In the average ground the wear on the steel is not severe. Ordinarily four sets of steel 2 ft. to 10 ft. are used to drill a heading with but a single sharpening. When in sandstone, however, three or four sharpenings may be necessary. The consumption of steel is 0.14 lb. per cu. yd. excavated.

LOADING AND SHOOTING.—As each drill finishes its regular holes, the driller and helper take it and the column arm down and out of the heading, so that when the last drill finishes its last hole, little time is lost in taking down and removing columns. Drills and columns are removed to about 100 ft. back of bench to protect them from flying muck and lights, runways, air line, etc., are removed. All holes are cleaned by blowing them out with compressed air. Then they are loaded with 60% Forcite, 0.8 lb. per stick. The number of sticks per hole is given below

Fig. 6. Victor electric fuses are used, inserted in one stick with one or two sticks placed on top. Firing is done with the lighting circuit of 220 volts alternating current. Shoot wires are strung on the opposite side of the tunnel from lighting wires; the connection and firing switch are 400 or 500 ft. back from the heading.

The cut, comprising six holes wired in series, is shot first, together with the bench, if but one round of bench is to be shot. Otherwise a round of bench is shot first and the cut is shot with the last bench round.

The bench holes are wired in series with leads from the main heading wires. It is frequently necessary to reload and shoot the six holes of the center cut twice or more to pull to the bottom. After this the six (or eight) relief and breaking-down holes are shot together and lastly the ten top dry holes and rib holes finish up the section.

The amount of powder per round and per yard of excavation is given in connection with Fig. 6, separately for heading and bench. As considerable trimming is necessary in the lower half of the tunnels, more powder will be used, but this will probably not increase the amount per yard of excavation.

SPECIAL METHOD OF DRILLING.—The above general method of tunnel excavating was departed from in Tunnel 3 North during the month of September, 1910, in an attempt for high progress which resulted in breaking the American record for driving hard-rock tunnels of large size. During September, 12-ft. steel was used in drilling the cut holes and 10 ft. in the side round holes, resulting in an average advance of 8.7 ft. per round or 523 ft. for the month. In order to drill the additional length of holes in an 8-hr. shift, two drillers and their helpers came on four hours before the regular drilling shift, mucked back the heading and set up columns and drills for the drilling shift.

FIGS. 8 AND 9. TWO VIEWS IN THE WALLKILL SIPHON TUNNEL DURING CONSTRUCTION.

MUCKING.—The muck is usually shot fine, almost entirely shovel muck. No block shooting has been necessary.

Considerable use has been made of steel plates for shooting muck on in the heading; these greatly facilitated mucking. The bench is usually shot against a pile of muck which prevents muck scattering along the floor of the tunnel.

The bench muck is shoveled directly into cars which are hauled close up to the muck pile on two tracks. The heading muck is wheeled in barrows along the top of the bench and out over the muck cars on runways supported on rails or pipe wedged across the horizontal axis of the tunnel. A belt conveyor was tried in one tunnel for a short time, but was discarded as impracticable.

The mucking gang of twenty men is divided into 11 shovelers, 4 pickmen and 5 wheelers. About two pickmen and three shovelers at the face of the bench muck shovel directly into the cars; the rest, scattered along the top of the bench and muck pile (which at times extends 30 or 40 ft. from the bench), handle the heading muck. The average number of cars mucked by a gang per shift is 37, a car containing about one yard solid or 1⅓ cu. yds. loose (the solid rock increases 67% in spoil). The amount of muck varies with the three gangs on account of the different amount of time lost from shooting; and the amount per man becomes less as progress in driving increases and the size of mucking gangs is increased. This is illustrated in the following table, where the first line represents conditions of normal progress, with small gangs, while the second line refers to high rate of progress, with large gangs.

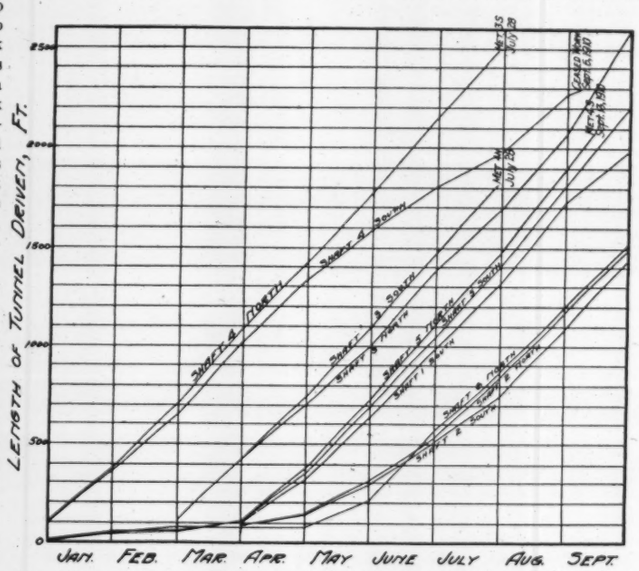


FIG. 10. PROGRESS DIAGRAM FOR THE HEADINGS OF THE WALLKILL SIPHON TUNNEL.

CUBIC YARDS SOLID REMOVED PER MUCKER, SHAFT 5.

Week ending	Progress of two tunnels.	Shift 12-8	Shift 8-4	Shift 4-12	Average.
July 31	182.5	1.62	1.73	2.03	1.80
Sept 4	199.	1.31	1.52	1.94	1.63

The time between the last shot and the next car of muck from the shaft is usually about one hour. In each 24 hrs. about five hours are lost from mucking, distributed as follows:

Taking down runways	25 mins.	
Shooting	60 mins.	
Replacing runways	35 mins.	
	2 hrs.	× 2 shifts 4 hrs.
Lunch period	20 mins.	× 3 shifts 1 hr.
		5 hrs.

As already stated hauling has been done by mules and trolley, the latter in tunnels from Shaft 4 and on the dump at Shafts 2 and 5. At Shaft 4 a mule pulled the muck cars out on to the single track and to a siding a few hundred feet from the bench, where the electric locomotive coupled on to three or four cars and hauled them to the shaft. One locomotive served both tunnels. At all other shafts mules haul the cars to the shaft in the level tunnel and they are braked down the 2% grade in the other, the mules following to haul an empty back. Up to lengths of 1,000 ft., one mule is used in each tunnel. Beyond that two mules are necessary, with a turnout for passing. On the dumps, one mule on a shift hauls all the muck.

SECTION EXCAVATED.—All tunnels have been excavated very well to line in the upper half of the section. There is no trimming left, nor have there been any considerable stretches of section much in excess. In the lower half of the tunnel, however, there is considerable trimming left to be done later, the contractor believing that this work can be done more economically after the expensive drilling organization is dispensed with. Fig. 7 shows a composite section of Tunnel 5 N., which represents about the average for all tunnels and one of Tunnel 6, which has been excavated closest to line, and with least trimming to be done later.

A study of the excavated section of tunnels from Shafts 4, 5 and 6 indicates saving in tunnel excavation, etc., due to careful methods on the part of the contractor as follows:

TUNNEL BREAKAGE.
(Cubic yards per lineal foot of tunnel.)

	Shaft 4 North.	Shaft 4 South.	Shaft 5 North.	Shaft 5 South.	Shaft 6.
Excavation above muck floor	7.26	7.95	7.52	8.11	7.63
*Unexcavated between B-line and C-line	0.35	0.18	0.33	0.31	0.37
*Excavation outside of B-line	0.00	0.18	0.01	0.05	0.00
*Net saving in excavation inside of B-line	0.35	0.00	0.32	0.26	0.37
	10.9%	0.0%	6.3%	5.1%	11.3%
Excavation outside of C-line	0.21	0.78	0.44	0.49	0.20
Per cent. of area of C-line	2.8%	10.7%	5.9%	6.2%	2.6%
Trimming inside of C-line	0.43	0.29	0.56	0.41	0.28
Per cent. of area of C-line	5.8%	4.0%	7.5%	5.2%	3.7%
Muck floor to C-line	1.07	1.17	0.98	0.57	0.86

*For upper half of tunnel only; other quantities are figured above muck floor.

PROGRESS.—The speed of the work on the Wallkill Tunnel has been exceptionally rapid and consistent. This is best seen in Fig. 10. Excepting for the tunnels from Shaft 2, where in the early months another type of drill and method of work was being experimented with, unsuccessfully, and in Tunnel 4 South, where exceptionally hard ground and scarcity of labor on account of wet roof interfered with progress, the pace has been very uniform and steady in all tunnels. The following table gives average and maximum weekly and monthly progress in all tunnels, which as a record of uniformly rapid progress stands foremost in America:

TABLE OF AVERAGE AND MAXIMUM PROGRESS IN EXCAVATION.

After installation of permanent hoisting plant:	Shaft 1 South.	Shaft 2 North.	Shaft 2 South.	Shaft 3 North.	Shaft 3 South.	Shaft 4 North.	Shaft 4 South.	Shaft 5 North.	Shaft 5 South.	Shaft 6 North.
Average monthly	312.3	257.5	247.0	343.4	325.4	343.8	270.6	351.1	340.5	326.9
Average weekly	71.6	59.0	56.6	79.2	75.1	79.5	62.3	80.4	78.1	74.8
Eliminating first two weeks for securing organization:										
Average monthly	325.4	274.8	262.9	356.2	342.3	352.1	274.4	368.3	354.6	334.2
Average weekly	74.6	62.8	60.1	81.6	78.3	81.6	63.3	84.3	81.2	76.7
Average daily	10.7	9.0	8.6	11.7	11.2	11.7	9.0	12.0	11.6	11.0
Maximum monthly	400	339½	360½	523	379½	379	368	424½	406½	367
Maximum weekly	96½	89	95½	132	98	99	92	103	100½	93

The run of 523 ft. of tunnel excavated in Tunnel 3 north during September is claimed as the American record for excavation of hard-rock tunnels of this size.

As already stated, the Wallkill Tunnel is being constructed by the Degnon Contracting Co., of New York City, Mr. H. C. Sandford, Chief Engineer, Mr. E. A. Herrick, General Superintendent.

Barring accident, the excavation of all tunnels of the Wallkill Siphon will be completed early in December, making 4.4 miles of tunnel excavated in less than one year.

Corrosion of Artesian Well Casing in Australia.

By C. O. BURGE,* M. Inst. C. E.

The great artesian basin of Australia is only second in extent of area to that of Dakota, and occupies large parts of the inland portions of the states of Queensland, New South Wales and South Australia, amounting to about [illegible] square miles in all. A comparatively small area of this, however, has been penetrated by bores, the balance being in practically uninhabited and unexplored country. Over 1,400 wells have been sunk, of varying depths, the maximum being 5,045 ft. Most of these wells have been yielding copiously for many years. However, there has been a falling off recently in some in New South Wales, and anxiety has been evinced with regard to the corrosion of the mild steel casing in that district, to which fact, as causing leakage, some of the farmers attribute the reduction in the yield. It is doubtful, however, if the diminished flow is altogether due to this cause, as the failing bores are all near the intake beds, and similar experiences of failure from this cause in Queensland seem to support this view. Silting of the bore-hole might also be a contributing cause. In consequence of complaints, inquiries have been set on foot by the state. The government has ordered from Great Britain, 5,000 ft. of wrought-iron casing for its own wells, and has offered to supply some of this to owners of proposed private bores at cost price, so as to eliminate as far as possible any loss of water which might be due to the deterioration of the casing. An investigation was originally made by Mr. W. M. Hamlet, government analyst, in 1901, and after analyses and tests had been recently made at Sydney University, the Under Secretary for Public Works explained to the water users that the deterioration was due to voltaic action caused by the presence of certain impurities in the steel which were considered to be necessary to its manufacture. He went on to point out that the question of producing a non-corrosive material at commercial prices had been an object of investigation for the past fifty years, but hitherto without much success. It had, however, recently come to the knowledge of the department that a material was being produced in the United States which might meet requirements in this respect. Approval has been given, therefore, for the purchase of a trial lot.

REFRIGERATOR BARGES have been put into service in New York Harbor by the Pennsylvania R. R. for the handling of dressed meats, provisions and other perishable freight. The situation at New York is unlike that at other Atlantic Ports in that there are no rail connections at steamship piers, so that freight must be delivered by floats.

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The Regulation of Telephone Rates and Service in Massachusetts.

Preliminary Studies.

The Massachusetts Highway Commission, on which is imposed by law the duty of supervising telephone service and rates in the state, early in 1910 retained Prof. D. C. Jackson, of D. C. & Wm. B. Jackson, Engineering Experts, to advise on certain problems which were encountered in the early survey of the field. Three specific questions were asked by the Highway Commission in blazing the way for the revision just made. These questions were:

(1) Is an appraisal of the plant of the New England Telephone & Telegraph Co. necessary before any satisfactory solution can be had of the general problem of what should be the equitable rates for service of said company throughout its Massachusetts territory, and, if so, how should such inventory and appraisal be made and what would be the probable cost of the same?

(2) Without prejudice to the general problem of what would be the equitable rates for service of the New England Telephone & Telegraph Co. throughout its Massachusetts territory, and in the absence of a complete inventory and appraisal of the plant of said company, is it possible to reduce the toll rates now in force in the Boston and Suburban division for toll business into and out from the so-called Metropolitan exchanges, and if such a reduction may be so made upon what basis should it be effected?

(3) With the same premises as stated in Question 2, in order to improve the quality of the service given by the New England Telephone & Telegraph Co., is it possible, and is it advisable, to change at the present time the multi-party lines in the Boston and Suburban Division to lines having not more than two subscribers thereon with the so-called "divided ringing" appliances?

The reply to the first question was that a properly planned and well executed inventory of the property of the New England Telephone & Telegraph Co. was necessary for any approach to the problem of equitable rates. This finding was based on the complexity of the telephone business, involved in the multitude of subscriber's classes and in the different investment and operating charges which needed to be charged against the several classes. It was found that the company did not possess records of investment, service-costs and traffic upon which equitable divisions of these charges could be made. The presumption then was that the rates in force were founded on individual judgment and business expediency with the best interests of the company and subscribers in mind.

It was reported that the work of an appraisal could best be carried on by the telephone company in consultation with the engineers of the commission by whom the plans for the work should be approved and the results verified. The total cost of the appraisal was estimated, from work done in Michigan, Wisconsin and Illinois, at from $50,000 to $60,000, of which expense $30,000 was held to be the burden on the Highway Commission. This covered the work of formulating comprehensive plans, supervising and verifying the work, placing values on the reported property and making the analysis of the accumulated data.

In answer to the second question, it was reported expedient to make at once a preliminary reduction of toll charges between telephones in the Metropolitan district and those in the suburbs, within a radius of five miles from the "telephonic center of gravity" of the Metropolitan service, from 10 to 5 cts. This was recommended principally because at that time the charge of 10 cts. was imposed alike on all subscribers within the limiting radii of 1½ and 15½ miles, and, secondarily, because even the meager data available on the traffic and load factors seemed to indicate that the old charges were excessive for the nearest subscribers.

The third question was answered negatively. It was found that the proposed change was very desirable, but that the change was so intimately related to the rate problem that it could not be made on an equitable basis. Therefore, it was recommended that the desired change be deferred until an appraisal had been made and more cost and traffic data had been accumulated.

The appraisal was ordered by the commission; funds were provided and the suggestions of Prof. Jackson were followed generally; the preliminary reduction of toll rates to suburban exchanges was put into effect; and the changes from multi-party operations were deferred.

Appraisal of Plant.

This appraisal was carried out by the telephone company, with its regular employees, along plans approved by the Highway Commission. The progress of the work was followed by Prof. Jackson as consulting engineer to the commission and the results were verified by him for the commission. The data gathered were reported to the commission in very great detail of course and, to present the main features, Table 1. to V. have been compiled from the summaries shown in Prof. Jackson's preliminary report on the appraisal. These tables do not show, however, the apportionments of central-exchange property to different classes of subscribers, by which investment, maintenance and depreciation charges are equitably distributed. These separations, as noted later, were not possible at the time of the appraisal, because of lack of data.

The value for any kind of property in Table II. includes the values of all the collateral property that can appropriately be put under the main division. Thus the first item, "substation equipment," embraces the cost, including installation, of instruments and fittings on the subscribers' premises. The item "poles and fittings" includes cross-arms, pins and hardware, set in place to receive insulators. The insulators themselves are grouped with "wires on poles." The figure for "aerial cables" includes the cost of splices, messenger cables and hangers, pole clamps, and cable-terminal boxes.

Table IV. shows that the value of the plant of the New England Telephone & Telegraph Co., is 16.3% greater than the capitalization, using the latter term broadly. This is reported to arise from the practice of the company in paying out of earnings, instead of capital, such expenses as engineering, contingencies, interest, etc. The engineers supervising the appraisal have concluded from a study of the expenditures for current repairs and reconstruction over the whole system, including states other than Massachusetts, that no extensions of plant have been made out of annual receipts in guise of reconstruction work.

However well cared for the poles, conduits, cables and wires may be, ultimately their further use is uneconomical or unsatisfactory without reconstruction and replacement. A second cause of reconstruction expense lies in improvements in the telephonic art, and a third cause may be recognized in unexpected attacks of the elements, in fires, in municipal-improvement ordinances. The average annual reconstruction rate, on the property used in Massachusetts business, is recommended to be 7.3% of the value of plant, exclusive of land, general supplies and working capital (see Table II). This amounts to $2,240,000 per year on the existing plant in Massachusetts. A definite figure was arrived at by considering the company's past experience, and by considering the cost, depreciation, probable developments, municipal demands and disturbances from the elements, for each kind of construction named in the appraisal. (Table II.)

Wires used for toll purposes have been separated from those for local service; the supports or enclosing conduits have been apportioned to toll or local-service plant in proportion to the number of respective wires. The value of central-exchange land, buildings and equipment have also been similarly apportioned. In the small cities and rural districts the differentiation between toll and local-service plant has been found clearly marked as each central exchange serves a fairly distinct community; in the Boston and Suburban District the differentiation was more difficult. However, the connecting trunks between the seven exchanges in the metropolitan

TABLE I.—INVENTORY OF THE PLANT OF THE NEW ENGLAND TELEPHONE & TELEGRAPH CO., IN MASSACHUSETTS.

Number of buildings owned by the company		53
Parcels of land owned by company		54
Number of exchange central offices		247
Number of operators' positions at exchange switchboards		2,367
Length of pole lines (approximate), miles		7,754
Length of underground conduits	feet	3,100,901
	miles	587
These comprise underground ducts	feet	14,370,649
	miles	2,721
Number of manholes in underground conduits		11,217
Aggregate length of pole lines and conduits, miles		8,341
Length of open wire on pile lines, miles		67,599
Length of aerial cable	feet	5,264,169
	miles	997
Length of conductors in aerial cables, miles		66,836
Total length of overhead conductors, miles		134,435
Length of underground cables	feet	6,663,360
	miles	1,262
Length of submarine cables	feet	52,400
	miles	10
Length of conductors in underground and submarine cables, miles		318,225
Aggregate length of aerial, underground and submarine cables, miles		2,269
Aggregate length of telephone conductors in all cables and wires, miles		452,660
Number of poles		310,138
Number of subscribers' telephones on Aug. 31, 1908		199,382

TABLE II.—VALUE OF PROPERTY OF THE NEW ENGLAND TELEPHONE & TELEGRAPH CO., BELONGING TO BUSINESS WITHIN MASSACHUSETTS.

Substation equipment	$3,217,240
Drop wires leading to subscribers' premises	668,315
Poles and fittings	4,260,173
Conduits and manholes	7,588,632
Wires on poles	2,724,017
Aerial cables	1,465,213
Underground and submarine cables	4,718,066
Switchboards	4,094,067
Furniture and tools	453,078
Land and buildings (land $470,000; bldgs, $1,874,469)	2,344,469
*General supplies	1,040,000
**Net current assets and cash on hand	1,560,000
Total	$34,133,270

*Book value, from auditor.
**Round figure representing average condition.

TABLE III.—VALUE OF PROPERTY OF THE NEW ENGLAND TELEPHONE & TELEGRAPH CO. BELONGING TO BUSINESS OUTSIDE OF MASSACHUSETTS.

Apparatus and equipment	$9,771,766
Land and buildings	210,783
*Investment in other companies	1,945,000
**Net current assets and cash on hand	480,000
Total	$12,407,549

*At cost value, from auditor.
**Round figure representing average condition.

TABLE IV.—DIVISION OF PROPERTY VALUE OF THE NEW ENGLAND TELEPHONE & TELEGRAPH CO. BETWEEN THAT BELONGING TO BUSINESS WITHIN MASSACHUSETTS AND THAT BELONGING TO BUSINESS IN ADJOINING STATES, TOGETHER WITH THE TOTAL VALUE OF PROPERTY.

Value of property belonging to business within the Commonwealth of Massachusetts	$34,133,270
Value of property belonging to business in Commonwealths adjoining Massachusetts	12,407,549
Value of entire property of the New England Telephone & Telegraph Co	$46,540,819
Total par value of the company's outstanding stocks, bonds and notes, as given by the company's auditor, for Aug. 31, 1908	$38,939,850

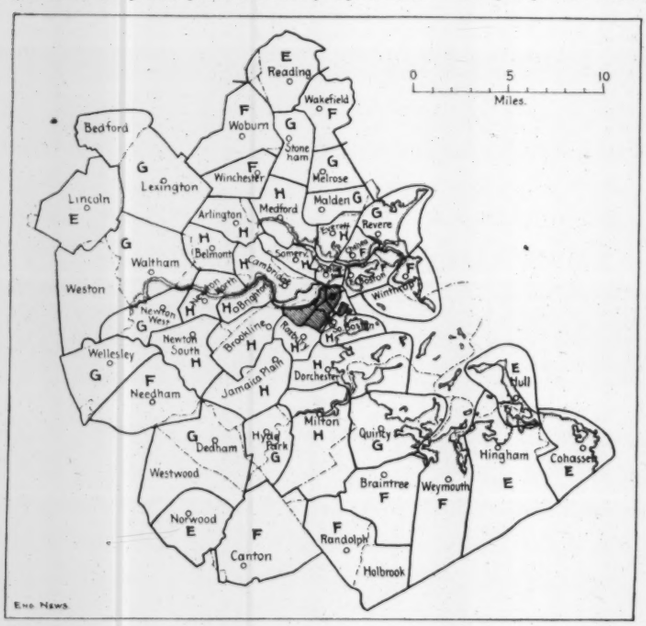
TABLE V.—DISTRIBUTION OF PROPERTY OF THE NEW ENGLAND TELEPHONE & TELEGRAPH CO., IN MASSACHUSETTS.

GENERAL DISTRIBUTION OF PROPERTY:		
Local Plant:		
Metropolitan, Boston		$4,493,845
*Boston Suburbs		6,446,838
†Eleven cities of 50,000		6,872,411
Small Cities, Rural Districts		5,079,248
†Total		$22,885,082
Toll plant		$9,641,913
Working funds		1,500,000
DISTRIBUTION OF TELEPHONES.		
Metropolitan Boston		42,749
Main	20,201	
Private branch	17,143	
Extension	5,405	
Boston Suburbs (within Five-Mile Radius)		34,888
Main	29,672	
Private branch	2,519	
Extension	2,697	
Boston Suburbs (beyond Five-Mile Radius)		19,456
Main	16,875	
Private branch	702	
Extension	1,879	
Eleven Large Cities		56,729
Main	45,516	
Private branch	5,113	
Extension	6,100	
Small Cities and Rural Districts		54,540
Main	48,558	
Private branch	1,892	
Extensions	4,090	
†Total		199,382

*Of this, $3,983,940 is within a radius of five miles of the "telephonic center of gravity" of metropolitan district, and $2,462,898 is beyond.
†Brockton, Cambridge, Fall River, Holyoke, Lawrence, Lowell, Lynn, New Bedford, Somerville, Springfield and Worcester; it should be noted that the property in Cambridge and Somerville comes into the total for the suburban area and also for the eleven cities.

district proper have been considered, in the summaries, as part of the local-service plant on account of the close inter-relations of all sections served by these exchanges. In making the appraisal, nevertheless, the amount and value of these connecting trunks have been preserved to allow further study of this apportionment, should it be advisable. In the suburban district, all circuits between central exchanges have been considered as for toll service, but the investment in trunking plant, as shown later, was apportioned to toll and local-service plant.

By this appraisal it was found that the amount and distribution of the company's property in the state and the separation in to local and toll-line plant had been secured as a foundation on which the study of rates in all parts of the state might be made. Full traffic data and information was still found lacking concerning the company's expenditures for operating and repairs; it was recommended by Prof. Jackson in 1909 that a system of analytical records should be devised to secure this data and to apportion the expenditures to local toll-line traffic. Also continuous records to keep the plant inventory up to date were advised. These records were preferably to be secured by co-operation between the telephone company's experts and the consulting engineers and accountants of the commission.



THE BOSTON AND SUBURBAN DISTRICT OF THE NEW ENGLAND TELEPHONE AND TELEGRAPH CO.

(Showing present central exchanges, proposed overlapping zones and political divisions not coinciding with zones.)

To carry out the proposed work, following with a careful study leading to the adjustment of subscribers' classes and rates on an equitable basis, it was estimated that $35,000 would be required. The time needed was not less than a year.

Revision of Existing Rates.

The work recommended as noted in the preceding paragraph was carried out by Messrs. D. C. & Wm. B. Jackson for the Commission, attention being first given to rates for the Boston and Suburban District, so called. The first visible result was a report transmitted to the commission on Feb. 14, 1910, which has been made public recently, reviewing the present rates and their faults and presenting a scheme for grouping the suburban subscribers into community zones and service classes therein with rates based on actual investment, depreciation and cost of operating.

PRESENT RATES.—The Boston and Suburban District comprises the city of Boston and 50 cities and towns around it in an area of some 435 sq. mi. In the purely Metropolitan territory of about 4 sq. mi., late in 1909 and a few months after the appraisal, there were, approximately, 48,800 telephones of all kinds, only 22,000 of these, however, representing distinct subscribers, the others being extensions and private branch terminals. An idea of the relative proportions may be had from Table V. In the suburban district alone there were at this time 63,900 total telephones, representing, however, only 54,400 distinct subscribers. Five classes of rates are now furnished in this district: (1) For telephones located anywhere in the Boston and Suburban District providing one and two-party line service to all parts of that district without extra charge; (2) a similar service but with measured service, a minimum charge, and a charge for messages above the minimum number; (3) for telephones located in the Suburban District and affording single and multi-party line service without extra charge only in that district, with an extra charge for service into the metropolitan area; (4) for party-line coin-box telephones in the metropolitan district, for which a charge of 5 cts. is made for messages to exchanges within five miles of the telephonic center of this district and from which a charge of 10 cts. is made for messages to outlying portions of the suburban district; (5) for party line coin-box telephones in the Suburban District, from which a charge of 5 cts. is made to telephones in the same exchange and a 10-ct. charge is made for messages into other exchanges except within the five-mile radius of the center of the Metropolitan District, when the charge of 5 cts. is made. These rates are shown further in Table VI. In addition, the company has in force numerous miscellaneous rates covering short-time contracts, telephones at long distances from the centrals, extensions, etc. This condition has arisen as the result of the consolidation of the separate companies.

FAULTS OF PRESENT RATES. — The development of telephone service in different parts of the territory shows wide differences, which are believed to be greater than necessary and due to the character of the rates in effect. The Jackson report noted holds that the importance of good service for the small users has not been adequately recognized as affording stability to the telephone service throughout the district.

The average rates paid, per message, in various classes range from about 2 to 8 cts. The lower figure applies to the metropolitan single-party unlimited business lines and to the six-party unlimited suburban-residence service. The higher prices are found in the single-party and two-party measured-service suburban lines having various rates for metropolitan calls. The average charge per message for all classes of service, exclusive of inside calls in private branch service, is 3.46 cts. It is found that 73% of the first class of subscribers mentioned in the Metropolitan District, and 64% of the same class located in the Suburban District, are getting their service at a figure lower than the average price per message. While it is reported that the rates for this first class of subscribers may be fairly somewhat lower than the general average, because of shorter circuits and smaller investment per message, etc., yet it is certain that large users in many of the classes are obtaining their telephone service substantially at an expense to other users.

REARRANGEMENT OF TERRITORY.—The idea of the rearrangement in brief is founded upon a combination of measured and flat-rate service in restricted zones, with toll charges for messages crossing the borders of these. With such an arrangement subscribers with relatively similar wants may be naturally grouped together so that it is possible to provide a class of service attractive to the greatest number of the possible subscribers while eliminating the opportunity for individual subscribers to increase their telephone service largely at the expense of others. By thus grouping subscribers with similar wants into distinct classes, the burden of expense for operating, maintenance, depreciation and interest is best distributed. Both measured and flat rates are considered justifiable in these zones so long as the classes of subscribers include those having fairly similar wants.

All of these zones are to be operated as overlapping, so that each suburban subscriber may have service with all of his neighbors without extra charge. Each free area in the suburban district, according to the proposed plan, will consist of the area included in the exchange district of a subscriber originating the message together with the area of the adjacent suburban exchange districts. Each one of these districts comprises a fairly popular center surrounded by a section comprising a more scattered population. Thus for instance a subscriber in the Belmont zone (see accompanying figure) may call without extra charge any subscriber in the Lexington, Waltham, Watertown (Newton), Cambridge and Arlington zones. A toll charge has to be paid for messages going beyond the overlapping district.

The forty-four suburban zones are grouped into four classes, designated as H, G, F, and E. The first grade, H, comprises those central exchanges having not less than 10,000 or more than 25,000 main telephones; the second grade, G, comprises exchanges in general having between 5,000 and 10,000 main telephones; the third grade, F, is formed of exchanges having between 2,500 and 5,000 main stations in service, while the fourth grade, E, comprises zones having less than 2,500 main stations. It will be seen from the figure that there are as many overlapping zones as there are central exchanges, each central office becoming the center of a zone. These zones are considered sufficiently compact so that unlimited local-service rates may be equitably established, while measured-rate and coin-box service lines are made attractive.

The combination of flat and measured rates within any single zone is possible because of the fairly homogeneous activities and population within the zone, so that the difference between the highest-paying (per message) and lowest paying flat-rate customers is comparatively small. The inclusion of measured rates makes it possible to reduce the price of service to the small users to the smallest fair annual charge to cover interest, depreciation and maintenance. By such measured service in a zone system as proposed, the service throughout the metropolitan and suburban districts should be extended to the small users who are unwilling to pay much over $20 per year, but who may be made profitable customers for the company if rates are adjusted on the proposed basis. The inclusion of such subscribers increases the value of the telephone service to the larger users.

No overlap has been made for the metropolitan zone with its seven exchanges, as it is held to be geographically and commercially distinct.

BASIS OF NEW RATES.—The proposed rates are based on two main factors: (1) the annual fixed charges of providing for the subscribers' possible wants, investment back of this depending not only on the cost of the plant required to connect the subscribers to the exchanges, but also on the amount of traffic which is handled over the subscribers' lines, as it is evident that one operator and her switchboard equipment can handle the messages from a larger number of customers who call only at infrequent intervals than if these customers are all keeping their telephones very busy; (2) the actual cost per message for furnishing the traffic. The investment required for each class of telephone service above was divided into two parts; one is independent of the number of messages originated by the subscribers and may be determined by the apparatus which must be provided to give

connections required by that class, which ce, however, may be slow and unsatisry whenever several subscribers desire ser- simultaneously; the other division of the investment changes approximately according to the ratio of the number of messages originated by the class, and includes the additional plant required to enable the telephone company to give quick service to each subscriber at any time. An equitable schedule of rates therefore must take into account the investment necessary to give the peculiar service required by the different

TABLE VI.—TELEPHONE RATES, PROPOSED AND IN EFFECT; BOSTON AND SUBURBAN DISTRICTS.

TON METROPOLITAN DISTRICT.

Rates.	Service.		Zone of Service.	Messages included in Minimum Annual Charge. One-party.	Messages included in Minimum Annual Charge. Two-party.	Additional Local Messages (each). 300 Cts.	200 Cts.	All Others. Cts.	Minimum Annual Charge. One-party.	Two-party.	Four-party.	Extension. Set. Regular.	Extension. Set. Special.	Extension. Bell. Charge.	Extension. Bell. Free.
osed rates for al service in tropolitan district.	Unlimited	Business	Metropolitan	Unlimited	....	...	...	....	$125.00	....	....	$12.00	....	$1.50	1
		Residence	Metropolitan	Unlimited	....	...	...	....	75.00	66.00	....	12.00	$8.00	1.50	1
	Measured	Business	Metropolitan	960	840	...	...	3	48.00	42.00	....	6.00	....	1.50	1[4]
		Residence	Metropolitan	840	720	...	...	3	42.00	36.00	....	6.00	5.00	1.50	1[4]
	Coin-box	Business	Metropolitan[1]	...	....	...	...	....	60.00[2]	....	36.00[2]	....	....	1.50	..
		Residence	Metropolitan[1]	...	....	...	...	....	....	....	24.00[2]	....	....	1.50	..
	Receiving	Business	Metropolitan	...	....	...	...	....	36.00	....	....	....	....	1.50	1
		Residence	Metropolitan	...	....	...	...	....	36.00	....	....	....	....	1.50	1
	Short-term	Business	Metropolitan	...	....	...	...	....	....[5]	....	....	....	....	1.50	..
		Residence	Metropolitan	...	....	...	...	....	....[5]	....	....	....	....	1.50	..
		Receiving line	Metropolitan	...	....	...	...	....	....	....	....	....	....	1.50	..
	Mileage	Business	Metropolitan	...	....	...	...	....	2.50	1.00	.50	....	....	....	..
		Residence	Metropolitan	...	....	...	...	....	2.50	1.00	.50	....	....	....	..
tes in effect for tropolitan and suburban district.	Unlimited	Business	Metropolitan and Suburban	Unlimited	....	...	...	....	162.00	....	....	18.00	....	1.50	1
		Residence	Metropolitan and Suburban	Unlimited	....	...	...	....	116.00	90.00	....	18.00	8.00	1.50	1
	Measured	Business	Metropolitan and Suburban	600	500	5	5[3]	3	60.00	45.00	....	6.00	....	1.50	1
		Residence	Metropolitan and Suburban	600	500	5	5[3]	3	60.00	45.00	....	6.00	5.00	1.50	1
	Coin-box	Business	Metropolitan and Suburban[1]	...	....	...	...	....	....	....	36.00[2]	....	....	1.50	..
		Residence	Metropolitan and Suburban[1]	...	....	...	...	....	....	....	30.00[2]	....	....	1.50	..
	Receiving	Business	Metropolitan and Suburban	...	....	...	...	....	36.00	....	....	....	....	1.50	1
		Residence	Metropolitan and Suburban	...	....	...	...	....	36.00	....	....	....	....	1.50	..
	Short-term	Business	Metropolitan and Suburban	...	....	...	...	....	54.00	....	....	10.00	....	1.50	..
		Residence	Metropolitan and Suburban	...	....	...	...	....	38.67	24.00	....	10.00	....	1.50	..
		Receiving line	Metropolitan and Suburban	...	....	...	...	....	18.00	....	....	....	....	1.50	..
	Mileage	Business	Metropolitan and Suburban	...	....	...	...	....	2.50	1.00	.50	....	....	....	..
		Residence	Metropolitan and Suburban	...	....	...	...	....	2.50	1.00	.50	....	....	....	..

[1]Under existing rates 5 cts. pays for one message to any exchange within 5 miles of the Metropolitan centre. Under proposed rates 5 cts. pays to any exchange within 8 miles.
[2]Monthly guarantee of 1/12 this figure.
[3]Over 200 on two-party line at 3 cts. Also no free extension bell on two-party lines.
[4]No free extension bell on two-party line.
[5]Three months' service at existing proportions; each additional month at 1/9 difference between annual and three-month rate until full annual rate is reached.

BOSTON SUBURBAN DISTRICT.

Rates.	Service.		Zone of Service.	Messages included in minimum annual charge. 1-party.	2-party.	3-party.	Additional local messages (each). 300 Cts.	200 Cts.	All others. Cts.	Minimum annual charge. One-party.	Two-party.	Three-party.	Four-party.	Six-party.[1]	Extension. Set. Regular.	Extension. Set. Special.	Extension. Bell. Charge.	Extension. Bell. Free.
Proposed rates for local service in zones.	Unlimited	Business	E	...	...	...	...	...	...	$48.00	$42.00	.....	.....	.....	$9.00	.....	$1.50	One free bell allowed on each one-party line.
		Residence	E	...	...	...	...	...	...	30.00	21.00	.....	.....	.....	9.00	$8.00	1.50	
		Business	F	...	...	...	...	...	...	54.00	48.00	.....	.....	.....	9.00	.....	1.50	
		Residence	F	...	...	...	...	...	...	33.00	24.00	.....	.....	.....	9.00	8.00	1.50	
		Business	G	...	...	...	...	...	...	60.00	54.00	.....	.....	.....	9.00	.....	1.50	
		Residence	G	...	...	...	...	...	...	36.00	27.00	.....	.....	.....	9.00	8.00	1.50	
		Business	H	...	...	...	...	...	...	69.00	63.00	.....	.....	.....	9.00	.....	1.50	
		Residence	H	...	...	...	...	...	...	39.00	30.00	.....	.....	.....	9.00	8.00	1.50	
Proposed rates for local service in the zones.	Measured	Business	E	720	600	...	...	...	3	36.00	30.00	.....	.....	.....	6.00	.....	1.50	
		Residence	E	720	...	...	...	...	3	36.00	.....	.....	.....	.....	6.00	.....	1.50	
		Business	F	780	600	...	...	...	3	39.00	30.00	.....	.....	.....	6.00	.....	1.50	
		Residence	F	780	...	...	...	...	3	39.00	.....	.....	.....	.....	6.00	.....	1.50	
		Business	G	840	660	...	...	...	3	42.00	33.00	.....	.....	.....	6.00	.....	1.50	
		Residence	G	840	480	...	...	...	3	42.00	24.00	.....	.....	.....	6.00	.....	1.50	
		Business	H	900	720	...	...	...	3	45.00	36.00	.....	.....	.....	6.00	.....	1.50	
		Residence	H	900	480	...	...	...	3	45.00	24.00	.....	.....	.....	6.00	.....	1.50	
Proposed rates for local service in zones.	Coin-box[6]	Business	E	...	...	...	...	...	...	60.00	.....	.....	$30.00[2]	.....	.....	.....	.....	$1.50
		Residence	E	...	...	...	...	...	...	.....	.....	.....	21.00	.....	.....	.....	.....	1.50
		Business	F	...	...	...	...	...	...	60.00	.....	.....	30.00	.....	.....	.....	.....	1.50
		Residence	F	...	...	...	...	...	...	.....	.....	.....	21.00	.....	.....	.....	.....	1.50
		Business	G	...	...	...	...	...	...	60.00	.....	.....	30.00	.....	.....	.....	.....	1.50
		Residence	G	...	...	...	...	...	...	.....	.....	.....	21.00	.....	.....	.....	.....	1.50
		Business	H	...	...	...	...	...	...	60.00	.....	.....	30.00	.....	.....	.....	.....	1.50
		Residence	H	...	...	...	...	...	...	.....	.....	.....	21.00	.....	.....	.....	.....	1.50
	Receiving	Business	....	....	...	...	...	...	...	36.00	.....	.....	.....	.....	.....	.....	1.50	1.00
		Residence	....	....	...	...	...	...	...	36.00	.....	.....	.....	.....	.....	.....	1.50	1.00
Proposed rates for local service in zones.	Short-term	Business	....	....	...	...	...	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....
		Residence	....	....	...	...	...	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....
		Recvg line	....	....	...	...	...	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Mileage[7] From central office	Business	E, F, G or H	...	...	...	...	...	...	2.50	1.00	.....	.50	.....	.....	.....	.....	.....
		Residence	E, F, G or H	...	...	...	...	...	...	2.50	1.00	.....	.50	.....	.....	.....	.....	.....
	Mileage[7] From arbitrary center[5]	Business	E, F, G or H	...	...	...	...	...	...	5.00[8]	2.00[8]	.....	2.00	.....	.....	.....	.....	.....
		Residence	E, F, G or H	...	...	...	...	...	...	5.00[8]	2.00[8]	.....	2.00	.....	.....	.....	.....	.....
Rates in effect for Suburban service only, or for Metropolitan and Suburban service.	Unlimited	Business	Metrop'ltn & Suburban	...	...	...	...	...	...	162.00	90.00	.....	.....	.....	15.00	.....	1.50	
		Residence	Metrop'ltn & Suburban	...	...	...	...	...	...	116.00	.....	.....	.....	.....	15.00	8.00	1.50	
		Business	Suburban	...	...	...	...	...	...	84.00	66.00	.....	.....	.....	12.00	.....	1.50	
		Residence	Suburban	...	...	...	...	...	...	54.00	42.00	.....	30.00	25.00	12.00	8.00	1.50	
Rates in effect for Suburban service only, or for Metropolitan and Suburban service.	Measured	Business	Metrop'ltn & Suburban	600	500	...	5	...	3	60.00	45.00	.....	.....	.....	6.00	.....	1.50	One free bell allowed on each one-party line.
		Residence	Metrop'ltn & Suburban	600	500	...	5	...	3	60.00	45.00	.....	.....	.....	6.00	5.00	1.50	
		Business	Suburban	600	600	6.00	...	...	3	48.00	36.00	33.00	.....	.....	6.00	.....	1.50	
		Residence	Suburban	600	600	6.00	...	...	3	48.00	36.00	33.00	.....	.....	6.00	5.00	1.50	
Rates in effect.....	Coin-box	Business	Metrop'ltn & Suburban	...	...	...	...	...	...	60.00[2]	.....	.....	.....	.....	.....	.....	.....	$1.50
		Residence	Metrop'ltn & Suburban	...	...	...	...	...	...	.....	.....	.....	.....	.....	.....	.....	.....	1.50
Rates in effect for Suburban service only, or for Metropolitan and Suburban service.	Receiving	Business	....	....	...	...	...	...	...	36.00	.....	.....	.....	.....	.....	.....	1.50	1.00
		Residence	....	....	...	...	...	...	...	36.00	.....	.....	.....	.....	.....	.....	1.50	1.00
	Short-term	Business	Metrop'ltn & Suburban	...	...	...	...	...	...	54.00	.....	.....	.....	.....	10.00	.....	1.50	.....
		Residence	Metrop'ltn & Suburban	...	...	...	...	...	...	38.67	.....	.....	.....	.....	10.00	.....	1.50	.....
		Business	Suburban	...	...	...	...	...	...	28.00	22.00[8]	.....	.....	.....	8.00	.....	1.50	.....
		Residence	Suburban	...	...	...	...	...	...	22.00	18.00[8]	.....	.....	.....	8.00	.....	1.50	.....
		Recvg line	....	....	...	...	...	...	...	18.00	.....	.....	.....	.....	.....	.....	1.50	.....
	Mileage[7] From central office	Business	....	....	...	...	...	...	...	2.50[8]	1.00[8]	2.00	.50	2.00	.....	.....	.....	.....
		Residence	....	....	...	...	...	...	...	2.50[8]	1.00[8]	2.00	.50	2.00	.....	.....	.....	.....
	Mileage[7] From arbitrary center[5]	Business	....	....	...	...	...	...	...	5.00[8]	2.00[8]	2.00	2.00	2.00	.....	.....	.....	.....
		Residence	....	....	...	...	...	...	...	5.00[8]	2.00[8]	2.00	2.00	2.00	.....	.....	.....	.....

[1]Obsolete service which a few subscribers retain.
[2]Under existing rates, 5 cts. pays for a message within the originating exchange and 10 cts. for one into another suburban exchange. If originating office is within five miles of the Metropolitan telephonic center, 5 cts. pays for a message into the Metropolitan district. Under proposed rates, 5 cts. will pay for a message to any exchange within 8 miles of the originating exchange.
[3]For public pay-station service; deposits for toll calls pay on the guarantee.
[4]Short-term service; number of parties not limited except on one-party service.
[5]Arbitrary centers have been established only in a limited number of cases in large territory.
[6]Short-term service; limit of free mileage, one mile. Mileage charge for three months' service figured at ⅓ annual rate.
[7]Mileage charge is for each ¼ mile or fraction thereof added to the limiting radius.
[8]Guarantees include all receipts for service in whole Metropolitan and Suburban Districts.

classes and to handle the amount of traffic originated by the class. The first part of the investment, which may be called the "readiness-to-serve" part, includes the subscribers' lines and instruments and a small portion of the switchboards with proper parts of real estate and tributary property. The second part of the investment may be called the "service-rendered" charge; this particularly includes a large part of the investment in switchboards and auxiliaries, including their proper parts of real estate and tributary property and the connecting trunk service equipment.

The property required for each class of service must be maintained in order day by day, and must be placed as it depreciates. The charges for this should be apportioned to the subscribers in proportions depending (1) on their numbers, (2) on the character of the plant required by the several classes and (3) on the amounts of traffic in the subscribers' respective class. That is, one part of the maintenance charge is due to the mere fact of taking telephone service and requiring certain essential equipment, and the other is effected by the kind of line he subscribes for and the extent of his use of it. The company should obtain from each subscriber an annual sum depending upon the character of his line, even though he should not originate a single message, and additional sums for investment, maintenance and operation, depending upon the average amounts of the traffic of the different classes of subscribers.

In the Jackson report the minimum annual sum that the telephone company must now receive to meet interest and expenses entailed by the "readiness-to-serve" and the "service-rendered" investment is $20 for the average subscriber to a four-party coin-box telephone; $39 for the subscriber to a single-party measured rate business telephone, and $86 for the average subscriber to a single-party flat-rate business telephone. The difference between the last two figures is caused by the great increase in the "service-rendered" charge. These figures were obtained from the valuation of the company's property before noted and from the supplemental study of the company subscribers' traffic records and current-expense accounts. These figures are reported to be reasonably correct estimates only, since the existing accounting system of the company does not furnish the information required to make exact computations.

The additional costs of actually handling the traffic, day by day, have been considered, in the Jackson report, as uniformly apportioned between the messages in all zones. It is noted that this is not entirely exact as some messages require more operating force than others; for instance, a message between two subscribers whose telephones are connected to different central exchanges in the same zone.

The detailed arrangement of rates follows the classification of the subscribers. For instance, the subscriber on a single-party, measured-rate line, using it only four or five times a day, may be grouped at one central exchange panel with a hundred others of his class, and all their service may be cared for by a single operator even at the busiest part of the day. The flat-rate subscriber, making 40 or 50 calls per day, causes a demand on the operator's service which is so great that, in the busy hours of the day, one operator can take care of only a few such subscribers. Here it is evident that subscribers who originate many messages during a particular hour only, may be less economically served than subscribers whose service is uniformly distributed.

PROPOSED RATES.—In the metropolitan zone, comprising all the metropolitan exchanges, three flat rates for unlimited local service are proposed; a single-party rate business rate of $125; a single-party residence rate of $75; and a two-party residence rate of $66 per year. The prices for measured service in this zone are based on making 5 cts. the maximum charge for any local message, provided that the user chooses the proper class of service so that his annual use does not fall below a reasonable minimum number of messages. A proposed price for messages in excess of the guaranteed minimum is placed at 3 cts. These measured-service rates are: Single-party business service, 960 messages for $48; single-party residence service, 480 messages for $42; two-party business service, 840 messages for $42; two-party residence service, 720 messages for $36. Coin-box rates for this zone are 5 cts. per message with $5 per month guaranteed for one-party lines, and $3 per month for four-party lines. All these are given in detail in Table VI.

The rates for the suburban zones are graduated according to the classes of zones previously noted. The proposed new single-party business line flat rates in these zones are $48, $54, $60 or $69 per year, depending upon the class of the zone. The lowest single-party flat-rate residence lines will cost $30, $33, $36 or $39. The proposed measured rates are based on 5 cts. per message up to a fixed minimum per year and 3 cts. per message in excess of the guarantee. The highest figure presented in the proposed rates in these suburban zones is 900 messages for $45, which is the single-party business rate. Two-party, measured-rate, residence telephones are provided in zones of the highest grade at $24 minimum charge (5 cts. per message for the first 480 messages) and 3 cts. for additional messages. Coin-box service is provided on four-party lines at one rate in all grades of suburban zones. This seems reasonable as it has been held impracticable to divide the nickel. The guarantees are made as $2.50 per month for business service and $1.75 per month for residence service. All these charges may be studied in detail in Table VI. In that table, the proposed and existing main-telephone rates are tabulated for comparison. These rates apply only when pole-line or conduit facilities are available, and for contracts of one year duration. The metropolitan rates are for service within one mile of the central exchange in the case of business subscribers and within two miles for residence telephones. The suburban rates are for service within two miles of the central exchange or one mile from an arbitrary center in extended territory. Mileage charge per ¼ mile is added beyond these limits. In measured service rates, each connection of five minutes' duration, or fraction thereof, counts as one call. A receiving telephone will not be installed unless the subscriber has a regular instrument and the extension-set rate is according to the service. The short-term service rates are for three months or less for regular instruments and five months or less for extension sets; additional time at proportional rates until total charge equals annual rate.

The proposed toll-line rates for messages originating in one zone and going into another, beyond the overlap, are 5 cts., when the receiving central office is within 8* miles of the originating central office. An additional 5 cts. is charged for each addition of 8* miles or fraction thereof to the radius. It has been found that, of all the messages originating in the suburban exchanges only 14% are suburban interzone messages, 20% go into the metropolitan zone and 60% are strictly local. Some 72% of the messages originating within the metropolitan zone are local and the most of the remaining end within the 8*-mile radius.

The reasonableness of the proposed rates is checked in the Jackson report by analyzing to see how they may secure, from the average subscriber in each class of customers, the proper annual operating cost, maintenance and depreciation determined for that class and also a proportion of the reasonable return on the investment. As the requirements of Boston and its suburbs impose on the whole system a proportionately more expensive service on account of a speed and accuracy which is not necessary outside, this has been included as a factor in determining these rates. The average operating cost is determined from the telephone company's book records as a cost per message. The costs of general expense, superintendence, advertising, current repairs, etc., etc., are determined f[rom] the company's book records. The depreciation [charge] is a percentage of the investment det[ermined] from the records of the appraisal of th[e com]pany's property. Party-line subscribe[rs are] charged with a part of the cost of one su[b]scriber's line and switchboard connection, the [appro]priate charge per subscriber for each clas[s being] determined from the company's records. The average line costs per subscriber are det[ermined] from the values found by the appraisal of the company's property. The investment co[st] the portion of the trunk plant which is [known] needed for free-trunking service on overl[apping] zone calls is charged to local service. The to[tal] investment in trunk plant apparatus, real e[state], furniture, etc., is obtained from the apprais[al] and is divided between free and toll trunking [plant] according to the ratio of free trunk mes[sages] (in overlapping zones) to the number of [mes]sages for which a toll charge is made. Th[e in]vestment in local-plant switchboards is d[ivided] among the various classes of subscribers as follows: the investment for the whole suburban district is divided among the four grades of [zones] in proportion to the total number of local and contiguous calls originating in the exchanges of the respective grades. The investment thus apportioned is distributed among the various classes of service in proportion to the total number of local and contiguous calls originated by their respective classes. Within the metropolitan zone the division of corresponding investment is carried out in a similar manner, except that it does not need to be split between grades of zones. The total investment required for an average subscriber is then the sum of the average investment in individual equipment and the portion of the investment per subscriber in general local and trunk-plant equipment apportioned to his class of service. The actual rates, which may be considered equitable assets, are fixed by adding the average current expense of the telephone company, taken from their records, to the apportioned interest and depreciation expenses computed from the investments noted.

The toll service throughout the state has been found reasonably well developed, but having a relatively low density of traffic compared with that existing in the Boston and Suburban District. It is considered proper, therefore, to adjust the toll rates between the proposed zones on a basis of a somewhat lower rate per message mile than applies throughout the major part of the state. This is particularly the case as in the Boston and Suburban District, where a named person is not called to the telephone, but the conversation exists between numbered telephones. The toll rate for a three-minute message for distances up to 50 miles between the rural districts of the state ranges from 1.6 to 0.65 cts. per message mile, decreasing over this distance to approximately 0.6 cts.

It is seen that it is considered practical to establish various individual rates in the several zones without interfering with the organization of the district as a whole. It is believed that the zone system will prove flexible, to meet the demands of service, through the chance of adding new territory to zones.

STATEWIDE EFFECTS.—The Boston and Suburban District has a population which is about 40% of the total population of the state, while the number of main telephones is about 45% of the total number in the state. Therefore, the proposed change of rates in the Boston and Suburban District has been examined for its effect on the rest of the state. It is seen that nowhere, with the exception of Boston, has it been necessary to establish more than one central exchange within the limits of a city. Already the rates in these telephone districts are adjusted (more or less empirically) on a basis of the investment required and the expense of operating. Therefore, it is claimed that the proposed zone system for the Boston and Suburban District brings into operation the essential principles found in the rates in the outlying districts of the state and makes easy any future adjustment of rates singly and jointly as developments

*It should be noted that the original recommendations to the Commission put this distance at 7½ miles.

warrant and without interfering with the business.

The rates proposed in the Jackson report are expected to reduce the revenue of the telephone company in this Boston and Suburban District from $300,000 to $400,000 over the income obtained from the present rates. It is believed that the increased number of telephones following the introduction of the new rates will call for an investment of some $1,000,000 in the next two years. However, it is believed that the changes proposed will ultimately bring in a sufficiently large annual revenue so that proper returns will be paid on the increased investment and a margin will be left for surplus. By the proposed new rates a few users who are now getting their telephone service at less than equitable price will have to pay more for their service or will have to find some way of curtailing the extent of their service.

As the proposed rates directly affect nearly half of the telephone subscribers of the state and about half of the telephone company's investment, it is recommended that a further step should be taken by the Commission; this is to secure the advice of accountants, preferably associated with the Commission's engineers for the purpose of advising the telephone company as to how it may adjust its system of accounting and traffic recording so that the Commission may be informed from year to year in regard to the earnings and expenses pertaining to each class of service. These accountants would cooperate with the engineers in fixing a reasonable average expenditure for renewals of plant required by depreciation, and in fixing the maximum amount of reserves that ought to be maintained for this and other purposes, such as insurance. In this way progress in the rectification and revision of rates is to be carried on in other parts of the state as needed.

Annual Convention of the American Society of Municipal Improvements.

The 17th annual convention of the American Society of Municipal Improvements was held at Erie, Pa., Oct. 11 to 14. The attendance was fair in number and representative in quality, the program was good, varied in character, and though crowded was so carried through as to give time and to bring out discussion. The associate members had an interesting collection of exhibits, mostly in the paving and sewer pipe field. The weather was particularly fine, and added zest to the various excursions on land and water admirably planned and executed under the direction of Mr. B. E. Briggs, City Engineer of Erie.

The chief topics discussed at the convention were paving and sewage disposal, with paving in the lead. Various committee reports and papers dealt with other topics.

Amendments to the constitution were made to bring the formal declarations of the aims, objects, membership and procedure of the association into line with the actual facts. Many of these changes were in recognition of the fact that the membership is now by individuals rather than by cities—and it may be added that most of the individual active (or "corporate") members are city engineers and that the badge of the American Society of Civil Engineer was very much in evidence at the Erie Convention.

Opening Exercises.

After the usual preliminaries, the convention got down to business and heard the reports of its various leading officers. Mr. Julian Kendrick, of Birmingham, in a brief presidential address, stated that during the last two years he had spent considerable time in the northwestern part of the United States and Canada. He had found a growing feeling that membership in those sections should be increased, and suggested the formation of local branches of the Society (presumably not confined to the West). These branches might hold their meetings slightly in advance of those of the main society. All papers read before branches would be included in the annual volume of the Proceedings.

Mr. A. P. Folwell, Secretary, reported some fifty new members, including those elected at this convention, and a total membership of about 350, of which perhaps a sixth are associate members. The Society has a comfortable cash balance of about $700.

The secretary proposed various amendments to the constitution, to which reference will be made before the conclusion of this report. Practically all of the remaining sessions of the convention were devoted to the presentation and discussion of papers and committee reports.

Sewerage and Sanitation.

A progress report was sent by the chairman of this committee, Mr. Geo. C. Whipple, of New York City. The committee now has well under way tabulated and other data regarding every known sewage purification plant in the country. The completed report will be submitted next year.

THE PRESENT USE OF THE SEPTIC TANK.—A paper on this topic was sent in by Prof. H. N. Ogden, of Cornell University. After a brief historical review, the author stated that the extensive early claims for the tank have been disproved by experience. The tank has value for sedimentation purposes, liquefies or gasifies one-third of the solids which it retains and equalizes the flow of sewage. It gives some relief to filter beds, but may do them harm. The most intelligent opinion of the day favors small tanks, a brief period of detention, and relatively frequent cleanings—at least once a month in case the effluent is to be filtered.

In discussing the paper, Mr. Rudolph Hering remarked that in a recent visit to Europe the almost universal opinion which he encountered was that "the septic tank has gone; we have no further use for it." Mr. John D. Watson, of Birmingham, England, who has under his charge a large septic tank installation adopted before he assumed office, declares that if he was to start anew he would have no septic action. Mr. Hering thought Prof. Ogden's one-third sludge reduction by the septic tank must be taken as an average.

Mr. James Owen, of Newark, N. J., cited his installation of septic tanks at the Essex County Insane Asylum, Verona, N. J., nine years ago, as an instance of a great reduction in sludge production and consequently in operating expense. Mr. A. P. Folwell, New York City, remarked that Prof. Ogden and Mr. Owen were probably talking of tanks treating altogether different kinds of sewage; he also suggested that although Mr. Owen's tanks showed very little sludge deposit yet it might be that the humus passed out onto the beds. Mr. Geo. A. Carpenter, of Pawtucket, R. I., gave as his experience that the septic tank was no more effective than sedimentation basins in removing suspended matters and that the septic sludge was more difficult of disposal than ordinary sludge.

AERATION OF SEWAGE.—Experiments with aeration now being carried on for New York City were outlined by Mr. M. R. Sherrerd, of Newark, N. J. Air is forced through a baffled tank. It is thought that possibly a method of treatment may be devised which can be installed beneath the streets. Mr. Rudolph Hering reviewed briefly the various unsuccessful attempts to devise a practicable system of aeration during the past twenty-five years. He had always kept his "door open" to future possibilities with aeration. This summer an engineer of a large city told him of the application of aeration to percolating filters, with only slight air pressure, and with an increase of 50% in efficiency; but these results have been doubted. In the contract plans for sewage treatment now being advertised by Atlanta, Ga., provision is made for trying aeration of percolating filters by means of vertical pipes extending up through the beds at intervals of about 20 or 25 ft. These pipes are connected with the subdrains, and the main drain is trapped so the air cannot pass out. On the top of each of these vertical pipes will be a vane, turning with the wind. Air entering these pipes must escape through the material composing the bed. Dr. Rideal has calculated that so light a wind as 3 ft. per sec. would furnish air enough to oxidize sewage. The system will not work in cold weather, and so is being tried in the South.

SEWAGE DISPOSAL AT TORONTO.—Mr. C. H. Rust gave a brief description of sewage work now being done at Toronto. An intercepting sewer, screens, and settling tanks are being built and the effluent will be discharged into Lake Erie at a point 4¾ miles distant (air line) from the water-works intake. The 24 tanks will be 25 × 125 ft. in plan, and will be hopper-shaped in vertical section. The works are about one-third completed. The plans were approved by Mr. John D. Watson, of Birmingham, England, and Mr. Rudolph Hering, of New York City; the tanks have been designed by Mr. Watson.

EUROPEAN SEWAGE DISPOSAL.—Remarks on this subject, accompanied by lantern slides, were made by Mr. Rudolph Hering, based on a trip abroad last summer. The question of sewage disposal narrows down to the treatment of the solid and the liquid portions, respectively; and as to the liquid portion involves the question, how much of the burden shall be put upon land and how much upon water? In Europe, it is pretty well decided that a considerable part of the burden shall rest on the water, the percentage varying with different localities and conditions. Hamburg, Germany, with a million people, discharges all its sewage into the River Elbe with no treatment except screening. The sewage goes under water and cannot be seen or smelled afterwards.

When sewage is treated on land the problem is less simple. Much of the talk was devoted to what Mr. Hering said he believed to be the most important advance in sewage disposal where the sludge problem is involved; that is, the Emscher (or Imhoff) tank. This might be briefly described (although Mr. Hering did not use those words) as two circular tanks, each with a conical-shaped bottom. In the top of each tank is a shallow sub-tank, with a series of openings in its bottom, through which sludge passes into the larger tank below and is retained for digestion. The sewage passes through each of the two main tanks, by way of the corresponding sub-tanks. The sludge, which is drawn off from the bottom while the tank is in operation, is inoffensive humus matter and dries out readily on sludge beds, composed of sand above and gravel below.

MUNICIPAL SANITATION IN CUBA.—Mr. R. Winthrop Pratt, Chief Engineer of the Ohio State Board, who recently had a year's leave and served as Engineer of the Sanitary Division of the Government of Cuba, gave the results of various observations made by him in that island. Water-supply, garbage and sewage disposal were reviewed. In the course of his remarks, Mr. Pratt related that the three necessary evils of a household in Havana are a stable, a water closet and a kitchen, and that these are put close together.

Garbage Disposal and Street Cleaning.

On behalf of the committee on this subject, Mr. L. L. Tribus, Borough of Richmond, New York City, sent a brief report. Few important changes occurred in this field during the past year. The interest in the subject has largely increased, due to increased knowledge of the relation between flies and disease. At the refuse destructor in his borough improvements in method have materially reduced the time occupied in clinkering and charging, which was previously 16 minutes.

Mr. Rudolph Hering questioned there being any material relation between garbage, flies and the transmission of disease. How could there be, when garbage is merely rejected food or wastes from its preparation? Mr. Hering and others spoke of garbage disposal by feeding to hogs as satisfactory where the garbage is collected and fed while fresh. Mr. C. C. Brown said that the city of Denver has let a 5-yr. contract for garbage disposal for a total of $1; hog disposal being the explanation.

Mr. E. A. Fisher, of Rochester, stated that a garbage reduction plant has been operated near the center of his city for four years with scarcely any complaints of nuisance.

Mr. Clark G. Anderson, of Moline, wanted to

know what the smaller cities, say of under 25,000, were to do in the way of garbage disposal. His city, of about that size, had to give up a crematory on account of nuisance and cost. Later, the garbage was washed on the banks of the river, and fed to hogs, but the Federal Government stopped the discharge of the washings into the river. Now a contractor takes the garbage at the city limits for $125 per month and disposes of it by means not personally known to Mr. Anderson. Mr. Folwell suggested hogs or burial for cities of this size.

Street Paving.

This subject occupied considerable portions of several sessions. It was introduced by Mr. Wm. A. Howell, of Newark, N. J., Chairman of the Committee on Street Paving. Mr. Howell presented a general review of street paving work throughout the country. Creosoted wood block is being largely used. Asphalt block is gaining in New York City. A heavy yardage of bitulithic is being laid this year. Vitrified paving brick shows good reports. The specifications adopted by the Chicago convention of city officials last winter have been adopted by a number of cities. A second convention will be held in New York City, in January, 1911.

CLOSE - JOINTED CEMENT - GROUTED GRANITE BLOCK PAVEMENTS.—A paper on this subject, also by Mr. Howell, first described the granite quarries of New England and the methods in use for quarrying, cutting and dressing granite blocks. The 5-in. depth for granite blocks called for by the new specifications make it much easier to get a good joint space than under the 8-in. depth of the old specifications.

In 1909, Newark, N. J., used blocks of reduced depth under specifications calling for ⅜-in. cement-grouted joints, and for blocks in the joint faces deviating not more than 3/16-in. from a plane surface. The first year's work under these specifications was slow and difficult. Only about one-third of the blocks called for were supplied by the contractor. At first the engineers held the contractors rigidly to the specifications, but later slight concessions were made, including ½-in. joints. By the close of the present year Newark will have 6.65 miles of close-jointed, cement-grouted granite pavements. The surface is remarkably smooth. The average cost is about $3.15 per sq. yd.

In response to a question, Mr. M. R. Sherrerd, of Newark, stated that the granite blocks were made 5 ins. deep rather than 4 ins., to aid in laying them right-end up. He also said that the dressing necessary to give closer joints cost about 30 cts. per sq. yd., gross, but this is partly offset by savings effected.

BITUMINOUS PAVEMENTS, PATENTED AND OTHERWISE.—Quite a stir was caused by a paper on this subject, read by Mr. E. A. Kingsley, of Little Rock, Ark. Mr. Kingsley reviewed the history of bituminous pavements for forty years or more, and pointed out what he claimed were anticipations of the Warren patents for grading the stone and sand so as to fill the voids. He remarked that the number of patented and proprietary materials and processes is now so numerous as to make a pocket index necessary to keep track of them. He stated that notwithstanding improvements in machinery and methods the cost of bituminous pavements has gone up instead of down. This he attributed largely to the Warren patents of 1901-2-3, which, Mr. Kingsley stated, were on old methods, particularly on methods used by Hodgman in Denver, prior to his death in 1897. The patent litigation over Warren or bitulithic pavements was reviewed by Mr. Kingsley, and the opinion expressed that the various courts which have upheld the patents have done so against the facts.

To all this and more of the same general character, Mr. Geo. Warren replied that the Denver and other pavements cited were asphalt pavements, and not bituminous concrete, and that the courts had declared that the Warren patents had not been anticipated, neither at Denver nor at any of the other places brought forward by rival contracting companies. He urged that large particles in the aggregate are essential to make a material come under the title or name of concrete and that asphalt wearing surfaces are composed of sand, powdered limestone and asphalt.

Mr. M. R. Sherrerd said he had no quarrel with the bitulithic people, except in so far as they are not now following their own patent specifications. He thought they had gone too far in insisting on large-sized particles of stone in wearing surfaces. Under heavy traffic, iron-bound wheels rock these large stones and the automobiles suck out the fine material, so the bituminous pavement ravels like water-bound macadam. In repairs to bitulithic pavements which he has seen it has appeared that asphalt instead of tar was being used. Mr. Warren replied that changes had been made to keep pace with the progress of the day, but that his people have never departed from their basic principles.

Mr. Clark G. Anderson, of Moline, Ill., said that many cities were compelled by state legislation and by public policy to avoid patented articles, and that engineers were often justified in trying to get around patents. He was not well posted on the Warren patents, but it seemed to him that an engineer might be up against them in the proportioning of ordinary concrete.

ASPHALT REPAIRS AT SYRACUSE, N. Y.—Mr. Henry C. Allen, of Syracuse, described the system of asphalt-repair records used there. A total of 620,000 sq. yds. of asphalt has been laid in Syracuse since 1889, of which 500,000 are out of guarantee. The records show that during the sixth year of this pavement 0.2% of the area was repaired; tenth year, 2½%; twelfth year, 6%; fourteenth year, 16.9%, making a total of 37½% of the total area. The cost of repairs for the fourteenth year were 16.9 cts. per sq. yd. of total area of asphalt, and the total cost of repairs to that time was 52.8 cts. per sq. yd. The city has decided to resurface the entire street when an average of 37½% of the area has been repaired, and to charge one-third the cost of resurfacing upon the city.

Col. H. N. Rutan, of Winnipeg, Man., thought it was too bad to throw away 63% of the asphalt surface in this way. Mr. E. A. Fisher, of Rochester, said his own detailed figures of asphalt-repair costs taught him that repair costs for different streets have no meaning without knowledge of the corresponding amounts of traffic. Perhaps by using the surface heater (mentioned just below) the 63% of asphalt mentioned by the previous speaker could be saved.

Mr. C. D. Pollock, of New York City, said that in 1909 his city had resurfaced asphalt pavements the cost of repairing which the preceding year had been over 30 cts. per sq. yd.

LAYING ASPHALT WITH A SURFACE HEATER.—An associate member (Mr. B. B. Colborne, of the Equitable Asphalt Maintenance Co., St. Louis, Mo.) was permitted to show lantern slides and to talk at some length for the purpose of setting before the Association the merits of the Lutz surface heater. This device makes use of heated air instead of a flame for asphalt repairs and for resurfacing old pavements of other materials with asphalt. The speaker urged that the use of this device obviates the wasting of much good asphalt through the common practice of cutting out defective spots with an axe.

BRICK PAVEMENTS.—Mr. E. H. Christ, of Grand Rapids, Mich., stated that his city is having good results under the specifications of the National Paving Brick Manufacturers' Association.

RATTLER TESTS FOR PAVING BRICK.—Prof. Orton, of the University of Ohio, Columbus, O., gave a very interesting talk descriptive of some work designed to standardize rattler tests on paving brick. This work is being carried on in two independent series of carefully planned tests being made by Prof. Orton at Columbus, and by the National Paving Brick Manufacturers' Association at Indianapolis. So far as is humanly possible, the conditions surrounding the two sets of tests are absolutely identical. The two rattlers are identical in design and construction; a liberal number of brick is chosen from the product of various kilns and divided into two equal parts and sent half to one laboratory and half to the other.

On the first series of tests it happened that one of the laboratories started in before the other. Notwithstanding the identical test conditions which it was supposed had been established, the results were widely divergent. It turned out on investigation that at the Indianapolis laboratory shot from a local foundry had been used in this first series of tests, instead of awaiting the arrival of the Indianapolis portion of the grit in order for both rattlers. After the tests had been started up again, with shot from the same foundry, further divergences resulted, and on looking into the matter it was found that the foundry had not followed the specifications for the iron for the cubical and spherical shot—one being harder than the other. The lesson to be drawn from this experience is that minute attention must be given to every detail surrounding rattler tests of paving brick, in order to ensure comparable results. It may be added that the reason for entering upon this extensive series of tests was that since the standard rattler test of the Paving Brick Manufacturers' Association was adopted, some years ago, considerable complaint has been made that the results obtained in different places were not at all comparable.

Studies are being made to determine the best sort of material for rattler staves. To this end there are now being tried staves made of cast-iron, of channel-iron lined with steel, of manganese-steel and of three thicknesses of steel plates: ¼, ½ and ¾-in.

Before the tests were concluded, they will run into thousands in number and several carloads of brick from many manufacturers will be tested. Only one product will be used until a given series is run out. The revolution speed of the rattler will be kept uniform within a very slight variation. It is hoped that altogether the irregularities in the rattler, the shot, etc., can be so reduced as to bring everything within 1% of variation from uniformity.

Prof. Orton remarked that if brick will stand the rattler test, he cares nothing about the cross-breaking or absorption tests. It was brought out in the discussion that the standard brick specifications adopted last winter by the organization of city officials which met at Chicago eliminated all tests except the rattler test and the absorption test.

REPORT OF SUB-COMMITTEE ON WOOD BLOCK PAVING SPECIFICATIONS.—The Committee on Standard Specifications, the work of which appears to have been directed almost wholly to paving specifications, has appointed a number of special committees. One of these, headed by Mr. A. W. Dow, of New York City, submitted a report on standard specifications for wood block paving. Mr. Dow stated that the time since the appointment of this committee had been so short that it had not attempted to make many changes in the specifications agreed upon last winter at the Chicago convention of city officials interested in pavements. Such changes as had been made were designed for greater explicitness. A complete specification was submitted by Mr. Dow. Some of its main points are as follows:

The only woods covered are long-leaf pine, tamarack and Norway pine. The Chicago specification for oil is still recommended, but the committee thought that it should be broadened somewhat. Investigation has shown that the oil recommended, which was a coal-tar product, is not controlled by a single company, as has been alleged.

The majority of the committee favors a mortar-bed cushion for the wood blocks (the cushion, of course, to be placed on a concrete foundation and the blocks to be laid before the mortar sets), but a sand cushion has given such satisfactory results that it should be retained in the specifications as an alternative.

The committee advises that the blocks be treated with oil at the rate of 20 lbs. per cu. ft., but thinks that in the future it will be wise to lower

this amount, perhaps to 16 lbs., especially for Western cities. The report was received by the association and placed on file.

In a discussion which followed, Mr. J. W. Howard, of Newark, N. J., thought it was a mistake to exclude creosote oil, and also that it was wrong to require an average of 20 lbs. of oil per cu. ft., since this requirement means an over-dose in some of the blocks, and such over-dosing weakens the block. Considerable discussion, participated in by various members and by Mr. Lee, seemed to show conclusively that a less quantity of oil than 20 lbs. per cu. ft. is desirable in the light of data now at hand.

PAVEMENTS OF ERIE, PA.—Preparatory to an automobile trip to inspect pavements of various materials and ages in the city of Erie, Mr. Lynch, Assistant City Engineer in Charge of Pavement, read a brief paper giving the history and characteristics of the pavements of the city. It appears that sheet asphalt and brick predominate, but that there is some wood and more or less macadam. Considerable yardages of both asphalt and macadam, laid under various conditions, have been down for a long time and appear to be still in excellent condition.

Repairs to pavements are made by the city engineering department, from funds placed at its disposal for that purpose. A municipal asphalt repair plant has been proposed.

Paving and sewer inspectors at Erie are appointed after examinations to determine their fitness. The time is past when appointments to these positions are made for political reasons.

The sub-grade for pavements is rolled by a 10-ton roller owned by the city, but rented to the contractor at the rate of 1 ct. per sq. yd. covered. Brick gutters are laid, or are being laid, on all asphalt streets, and are generally 3 ft. wide. Some 100-ft. roadways have been parked in the center. The city is now paying about $1.50 per sq. yd. for asphalt on 5-in. concrete foundation, and about the same price for brick.

A point was raised by Mr. Will P. Blair, of Indianapolis, to the effect that sub-grades cannot be successfully compressed with a 10-ton roller, because the dirt will rebound. City Engineer Briggs seemed to be very strongly of the opinion that experience showed that the use of so heavy a roller was essential for searching out and remedying soft spots, particularly over sewers.

A paper entitled "The Economics of Highway Construction," by Prof. Arthur H. Blanchard, Providence, R. I., was read by title only, in the absence of the author.

Papers on Other Topics.

Besides the papers under the sewerage and sanitation and the paving groups, there were a number of others which also demand brief abstract or should at least be recorded by title.

SUPERVISION OF MUNICIPAL WORK.—Some interesting and forcible reflections on how not to conduct municipal improvements were submitted in a paper by Mr. Will P. Blair, of Indianapolis, Ind., Secretary of the National Paving Brick Manufacturers' Association. Mr. Blair first told of a city which, for a street of light traffic, put down 5-in. brick block pavement on 10-in. concrete base, thus wasting a large sum of money for unnecessarily heavy construction. Not content with this, the inspection of the paving work was entrusted to a lay member of the board of public works and he managed to mix things up pretty badly with the result that in a years' time this needlessly heavy and expensive pavement was in bad condition. Other instances of improper supervision of municipal work were cited and were contrasted with examples of good supervision. The paper closed with the statement that these improper conditions affecting the conduct of municipal work would never be remedied by efforts from outside the engineering profession. Mr. Blair thought the association before which he was speaking should take the lead in bringing about these improvements. He remarked that the great success of the General Electric Co. has not been brought about with employees selected on the personal recommendation of this, that or the other man, but that instead the company has picked men of good collegiate training. Finally, he said that engineers must not submit to dictation from anyone founded solely upon political reasons.

CORRELATION OF CURB AND SIDEWALK GRADES.—By the aid of formulas and lantern slides Mr. Clark G. Anderson, of Moline, Ill., elucidated this important but too-often neglected subject. Service to the public should be put first and esthetic effect should come next. Unfortunately, the interests of private property owners too often takes precedence over both. The formulas presented were somewhat lengthy, but were all solvable by simple arithmetic substitution. Level, ascending and descending grades, and combinations of these were discussed and illustrated. A plea was made for giving as much consideration to sidewalk as to roadway grades.

CHECK VALVES ON AUXILIARY WATER-SUPPLIES.—Mr. J. Walter Ackerman, of Auburn, N. Y., told how a typhoid outbreak in that city in 1908 had led to a thorough investigation of the check valves which were supposed to exclude from the regular domestic supply the polluted auxiliary supplies of various industrial establishments. Some of the old check valves had been in use for twenty years without inspection. Double check valves of a design similar to some already in use in New England have been installed since the investigation. These are provided with drips and with pressure-gage connections, are inspected frequently, and once in six months are completely dismantled. One or two of the new valves have been found which cannot always be relied upon, but never have both the valves of a pair been found to leak at the same time. Tests show that to bring the check valves into operation there must be a difference of 10 lbs. between the pressure of the two supplies.

SOME EXAMPLES OF STREET LIGHTING.—Mr. Joseph E. Putnam, of Rochester, N. Y., presented lantern slides and made some remarks on various methods of street lighting. He prefers small units, placed relatively low.

THE FINAL SESSION.—The fire committee reports and the two papers scheduled for Thursday afternoon were crowded forward to Friday because the convention had run a whole session behind its program. One of the papers thus displaced was on "Taxation." The other paper, on "The Census Bureau's Municipal Statistics," was by Secretary Folwell.

Amendments to the Constitution.

Numerous amendments to the constitution, suggested by Secretary Folwell and brought before the association with the endorsement of the executive committee, were acted upon almost without change by the society. Many of these amendments were made necessary by a radical change in the section defining and classifying membership. When the association was organized, the intention was to have the active membership almost, if not entirely, by cities. Each city which joined was entitled to be represented, apparently by as many of its officials as were in attendance at the convention, and all voting was to be done accordingly. Later, provision was made for individual membership on the part of city officials or consulting engineers engaged in municipal practice. As time has gone on, the city membership has entirely disappeared. The constitution was therefore amended to bring it into accordance with the actual status, or so as to provide for individual corporate membership and associate membership, the latter including supply men. A further amendment provided for affiliated members, which may include anyone sufficiently interested in the objects and work of the society to pay the anuual dues—$5 per year.

Another amendment cleared up an indefinite provision of the constitution as to the election of members. Hereafter, applications for membership may be acted upon at any time during the year, and members may be elected by a two-thirds vote of the executive committee. Any candidate who is rejected may appeal to the full corporate membership for election at an annual meeting.

Still another amendment adopted by the association provides that the annual meeting shall be held in one of the months, September, October or November, the exact date to be decided upon by the executive committee by June 1. The previously existing constitutional provision on this point set the second week in October as the date for the annual meeting, but gave the executive committee power to change it for any special reason which seemed to it sufficient.

The only other amendment which needs to be mentioned here was one making definite provision for permanent committees on street paving, street lighting, sewerage and sanitation, water-works and water-supply, disposition of garbage and street cleaning, park development and maintenance, standard specifications, municipal data and statistics and municipal legislation and finance. The last-named committee is a consolidation of three earlier committees dealing, respectively, with taxation and assessment, city government and legislation and municipal franchises.

Election of Officers and Place of Next Meeting.

Mr. Fred Giddings, of Atchison, Kan., was advanced from the position of First Vice-President to the Presidency; Messrs. A. Prescott Folwell, of New York City, and E. S. Rankin, of Newark, N. J., were re-elected Secretary and Treasurer, respectively. Grand Rapids, Mich., was chosen as the place for the next meeting.

Annual Convention of the American Boiler Manufacturers' Association.

The 22d annual convention was held at the Auditorium Hotel, Chicago, Oct. 10 to 13. Sessions were held on three days, and a trip to the steel works at Gary, Ind., occupied one day. The subject of the standardization of boiler design was brought up, and a committee was appointed to investigate and report upon this subject.

An address by Gen. Geo. Uhler, Inspector-General of the Steamboat Inspection Service, U. S. Department of Commerce and Labor, related particularly to the question of the production of boiler plate of the desired quality. Some eight or nine years ago, when considerable trouble was being had with boiler plate, the Board formulated specifications for boiler plate that met with considerable opposition on the part of the plate mills and dealers generally, they stating that the specifications could not be met. The Board invited representatives of all the plate mills in this country to state what they had to say on the subject. They replied that they could meet the specifications but that it would cost more money. With this statement before it, the Board stood by its specifications. But it was not long before complaints began to come from boiler manufacturers that the mills were refusing orders for steel plate under the new specifications and new requirements, claiming that the specifications were so drastic that it was impossible to roll them. To protect the manufacturers and itself, the Board produced the answers that had been made to the inquiries sent to the mills. He considered it quite possible for the mills to meet strict specifications and roll good steel.

Regarding the relative merits of safety valves of the spring pop type and the lever type, he said that the majority of the Board had decided that the old lever-type safety valve is an efficient and satisfactory type of valve for smooth water practice.

In reply to an inquiry, Gen. Uhler said that according to existing law the only value that can be allowed to-day for a triple-riveted butt strap joint of whatever gage or thickness of material, is the value that is allowed by that section of the law that provides that the triple-riveted shall be given 20% additional to the single-riveted joint. No greater value is given

for triple-riveted or quadruple-riveted than for double-riveted joints with the holes punched. This has been brought to the attention of the proper authorities, but will require an enactment by Congress before any change can be effected in the law.

The President, Col. Meier, called attention to the fact that after the joint agreement of Dec. 15, 1905, between this association and the American Steel Plate Association there had been persistent activity on the part of individual members of the latter (although not by the Steel Plate Association) which tended to devitalize that agreement. Such members made different specifications and argued in favor of them, so that the American Society of Testing Materials raised the limit of sulphur and phosphorus on flange steel. The Boiler Manufacturers' Association resolved, therefore, at its Detroit meeting (1909) to abrogate the agreement relating to the percentage of sulphur and phosphorus in steel plates intended for use in steam boilers, and to return to the original specifications of 1889. These fix 0.03% maximum for sulphur and 0.04% maximum for phosphorus.

Mr. Joseph H. McNeill, Chief Inspector of the Boiler Inspection Department and Chairman of the Board of Rules (of Massachusetts), stated that while in many cases boiler explosions result from a combination of conditions which include material, workmanship, operation, care and maintenance, yet there is no question but that explosions have resulted directly from faulty construction. He outlined a case where the shell plate fractured at the longitudinal joint, which was of double butt-strap triple-riveted construction. The fracture in this case extended between the rivet holes in the outer row, and careful investigation showed that the shell of the boiler at the joint did not conform to a true circle. The rivet holes had been punched almost full size, and in addition, in the portion of the plate which fractured clear through, incipient cracks were found at the rivet holes extending longitudinally with the boiler.

Under the enginemen's and firemen's license law of Massachusetts every person in charge of a boiler carrying a pressure exceeding 25 lbs. is required to keep daily records of the trying of the safety valves, water columns, blow-offs, and other appendages; also a record of the repairs and inspections made on the boiler. The effect of this keeping of a record on both employer and employee cannot be overestimated.

The prevention of steam boiler explosions is a general proposition in which the owner of the steam boiler as well as the manufacturer and the engineer in charge must all contribute their care. He believed that Massachusetts is in the lead in the matter of regulations governing the construction, installation and inspection of steam boilers and the licensing of enginemen and firemen.

Mr. Charles S. Blake, of the Hartford Steam Boiler Inspection Insurance Co., thought responsibility for explosions should be shared between boiler manufacturers, engineers and owners. He remarked incidentally that the manufacturers of tubes do not seem to be keeping up with the progress made by the manufacturers of other material entering into boiler construction. Higher pressures are being carried, but the standard commercial tube of to-day is no better than (if as good as) the tube of 25 years ago. Tubes should be stamped so that their source of origin could be located and the responsibility laid where it belongs when a casualty occurs through tube ruptures due to defect in manufacture. Tube failures are wofully common. Theoretically a tube will stand a greater internal pressure than external, but as a matter of practice a tube which is subjected to internal pressure more commonly fails than the tube subjected to external pressure. If the tube is defective in weld, external pressure tends to close the opening; with the internal pressure the tendency is to open it.

Mr. Durbin said he had been paying special attention to the matter of securing proper curvature to the plate. A gage is put on the plate as soon as it is turned out from the rolls. The butt straps are brought to absolute circle with a former by a large hydraulic press. The firm employs the Hartford Co. to inspect every boiler it manufactures. He believed that government supervision was necessary as well for land as for marine boilers, but the question of state's rights seemed to be the great bugbear. Congress appeared not to be vested with power except upon the waters and in the District of Columbia.

Mr. John J. Main (Toronto) instanced explosions, some of which were due to faulty material (where the steel by analysis showed too high sulphur). Others were due to both faulty material and workmanship, the boiler not being a true round and permitting constant "breathing" and a moving away from and returning to the circular form because of a long sheet underneath and two sheets overhead. He thought that there are too many poor boilers made. This demonstrates the necessity for a uniform specification to have the backing of law throughout Canada.

Capt. H. P. Norton, U. S. N., Bureau of Steam Engineering (Navy Department), said that in the navy they never empty a boiler when hot, but allow the boiler to cool off naturally. They close the boiler up, stop all circulation of air and let it cool off. He thought the best material is poor enough, and everything that is used by the navy must strictly conform to specifications. They require a safety valve to lift a certain distance, to open at a certain pressure and close at a certain pressure. An elaborate testing apparatus has been installed to determine the amount of lift, and this must be up to the requirements or the valve will be rejected.

In response to a remark about the inadequacy of taking the coupon from the edge of the plate as a test of value, Mr. John J. Main (Toronto) said that he thought this was right, because the edge was where the strain would be felt ordinarily.

Among the topical questions discussed were the following: (1) Is it difficult to make calking tight where plates are cut with a bevel shear? The answer was that it is not difficult if the material is of proper quality, the shears are kept sharp and the work is well laid out. (2) Why do pneumatic-driven rivets leak? The answer was that they do not leak if proper care is taken. But trouble will occur if too much air is used in the rivet-heating furnace, thus causing undue formation of scale on the rivets. (3) Does the regard for public safety necessitate destroying the right of a manufacturer to build a good boiler of his own design? This was answered by the following quotation from the Massachusetts law of May 14, 1909:

> When a person desires to manufacture a special type of boiler the design of which is not covered by the rules formulated by the board of boiler rules, he shall submit drawings and specifications of such boiler to said board, which, if it approves, shall permit the construction of the same.

The officers were re-elected: President, Col. E. D. Meier, New York, N. Y.; Secretary, J. D. Farasey, Cleveland, O. The next meeting will be held at Boston, Mass., in 1911.

The Emancipation of the Garbage Can.*

By DR. P. M. HALL.†

As a text for this discussion, let us quote the description of the "garbage receptacle" as found in a well-known book on sanitation:

> The garbage receptacle, especially when separation of true garbage is made, is usually one of the commonest forms of nuisance to be found. Every garbage can, unless it is emptied daily and thoroughly washed after emptying (which is practically never done) is in hot weather sure to be offensive. The annoyance from it can probably never be entirely done away with, and it is only with great care and at some expense that it can be reduced to a minimum.

A very little analysis will show that the sanitary condition of the garbage can has been the principal factor in determining the cost of the collection of garbage. It may be set down as an axiom in the collection of garbage that the cost of collection increases with the frequency of service. The ability of a man and team to collect is not the amount he collects, but the number of stops, the distance of travel, and the number of cans he is obliged to handle, so that a daily collection would necessarily cost more than a collection every other day, and a collection twice a week more than a weekly collection. The demand for frequent collection has arisen from and because of the sanitary condition of the garbage receptacle. Furthermore, undoubtedly, the unsightly condition of the garbage receptacle has had everything to do with making the mere mention of the word "garbage" an offense. Immediately come to our minds that same noisome garbage can.

Under existing conditions in almost every city, the can is as great, if not a greater nuisance, than the garbage itself. In the primitive days, the Indian, when tired of offense from the waste products of his house-keeping became too noisome, moved away, but in our day a generation we remove the garbage and keep the smell. Take the first step—the placing of the garbage, the waste food or droppings from our tables, into any kind of receptacles—wood, galvanized iron or what-not, and with the presence of heat, moisture and flies, you will very soon have a foul, maggoty, fly-breeding mess of putrefaction. Such a mess is necessarily a nuisance, requires frequent removal, and is a nuisance every time it is handled from the can to final disposal. Is it necessary that this condition of things should be? Is there no way to eliminate these breeders of putrefaction—heat, moisture and the fly? Is it not a little bit inconsistent that we legislate and talk about fly-infection when we are perpetuating the fly-nuisance in the garbage can by furnishing a most prolific breeding place?

It has been said that the annoyance of the can probably never will be done away with. It seems that this condition of things has been accepted everywhere and that nobody has tried. We find, however, exceptions in two cities—one in the United States and the other in Canada, where at least an effort has been made to keep the garbage can from being a constant nuisance, and that is what I have come to tell you about—how these two cities have been trying, and I will say with a great measure of success, to make the garbage can no longer a nuisance.

Drain garbage of all moisture, then wrap it in paper before putting it in the can and it will neither smell badly in hot weather, nor freeze and stick to the can in cold weather. Do this and have a clean can at all times.

Heat, moisture and the fly are all eliminated. This rule was put into practice in Minneapolis in February, 1907, and is still in force. The campaign of education was a hard one, but we have won. As one of the garbage collectors said to me within the week, "the garbage cans in my district are clean enough to keep pies in."

It all rests with the collector. He has but to report to the Department that the garbage is not properly drained and wrapped in paper, and no further service is rendered until the rule is complied with. If the householder then fails to properly care for his garbage or to have it cleaned up, he is brought into court and fined.

The operation of this rule has its economic as well as its sanitary side. The life of the can is very much prolonged. The garbage will roll out of the can in cold weather as well as in the summer; if it does not and the garbage is frozen, the can is not emptied, for the householder has failed to drain off the moisture. The collector is forbidden to carry or use a pick or crow-bar to dig out frozen garbage, so the can is not battered up.

Garbage kept in this way is not a nuisance; does not invite flies; needs to be collected but once a week even in warm weather, thus making a great saving in the cost of collection. It follows naturally that garbage which is not foul in the can will not be so in the wagon or cart.

The garbage can should be kept water-tight and when not so, should be discarded and a new one provided. A great deal of trouble has arisen from the tipping over of the cans by dogs. A recent invention in the shape of a small appliance on the cover makes the cover self-locking and the dog nuisance is a thing of the past.

The size of the can depends so much on the frequency of collection that it need hardly be discussed here. We have found that a 20-gal. can will take care of the garbage of an average-sized family for a week, and is easily handled by the collector. It is not necessary, even in a cold climate, to have different receptacles in the winter time, for if the rule regarding drainage of moisture and wrapping with paper is followed, a metal can is just as easily emptied and kept clean in the winter months as a wooden one.

The results of over three years of experience with this method of handling garbage in our city have been entirely satisfactory. At first it was laughed at as a fad of the department. We were asked when we would also require that the packages be tied with baby ribbon, but we persisted, and now the public is in accord with us, for they have seen actual results in the shape of clean, sanitary cans which are no longer a nuisance. Is it not a pertinent question that in the collection and disposal of garbage the first step should be a system of collection that gives to the citizen a garbage can which is no longer a nuisance?

*Condensed from a paper read before the Section of Municipal Health Officers of the American Public Health Association, at Milwaukee, Wis., September, 1910.

†Commissioner of Health, Minneapolis, Minn.

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The Presidents of the great railway systems of the United States have been before the Interstate Commerce Commission this week explaining why they think the railways should be allowed to make a horizontal advance in freight rates. President McCrea of the Pennsylvania and President Brown of the New York Central coincided in the declaration that the railways ought to be allowed to charge higher rates so that they might make larger returns to their stockholders. By doing this their credit would be established so that they would be able to sell securities for extensions and improvements.

It is curious that at the time when the heads of the two greatest railway systems were making such eloquent pleas of poverty, some of the secondary railway systems were reporting an astonishing degree of prosperity under present traffic and rates.

The Erie's annual report just issued for the year ending June 30, 1910, shows that both gross and net earnings were the largest in the road's history. Its net earnings above operating expenses were $15,765,000, a gain of $2,229,000 over the previous year, and eclipsing even the boom year of 1906-7. It is interesting to note that the net earnings were more than $7,000 per mile of road.

The Louisville & Nashville is also out with a roseate annual report, showing gross earnings over $7,000,000 greater than in the year ending June 30, 1909. The system earned more money, both gross and net, than in any previous year. Of the $7,000,000 increase in gross earnings, nearly $6,000,000 was in the freight department.

The balance of earnings after paying all expenses and interest on debt was equivalent to 17.65% on the outstanding capital stock and a 7% dividend was paid.

The Southern Ry. also reports the largest earnings in the company's history and a gain of $2,139,000 over 1908-9. The ratio of expenses to earnings on the Southern last year was 67.43%.

It is fair to add that these reports reflect the conditions existing during the 12 months from July 1, 1909, to June 30, 1910, and that the increases in wages which are the chief ground on which an advance of freight rates is now claimed to be justifiable, did not go into effect until so late in the year that they had no large influence on the year's expenses. On the other hand there was a considerable percentage of idle freight cars all last year and complaints of hard times by the railways were general. None would have supposed from the published statements of railway officers during all last year that such roads as the Erie or the Southern were carrying more traffic and earning more money and larger profits than even in the boom year of 1907. Perhaps that is one reason why the present testimony of railway officers before the Interstate Commerce Commission as to the parlous condition of the railway treasuries appear to be taken by the public *cum grano salis*.

One of the most interesting statements made by President McCrea was that the Pennsylvania expects no financial return whatever from its investment in the new terminal at New York City, the total expenditure on which has already been $97,000,000 and will eventually reach $108,000,000. To the question why the company spent this enormous sum of money on an investment yielding no return, President McCrea replied that the company had spent the money, because it thought the greatest city in the United States should have a suitable railway terminal.

If the above is really to be accepted as a valid justification of the investment in the New York terminal, then it behooves other cities to appeal to railways to do them equal justice. If the Pennsylvania can spend over $100,000,000 on a non-productive terminal for New York, why should it not spend $50,000,000 to $75,000,000 at Chicago or $25,000,000 at Cleveland and Columbus and half a dozen other cities and so on down the scale?

President McCrea claimed the Pennsylvania had paid for the New York Terminal out of its surplus earnings; but if these surplus earnings had been distributed to the stockholders to whom it really belonged, perhaps the credit of the company would be better to-day and the difficulty in marketing securities, of which he complained, would not exist. On the other hand there seems good reason to believe that the cost of the New York terminal has been in large part provided for by additions to the capital, or in other words by borrowed money. That is to say the shippers of goods are asked to pay for this terminal in the form of increased freight rates. Against such taxation the shippers have certainly good right to protest.

Engineering News has been foremost in pointing out that improvements to freight terminals are the most promising direction in which to spend money to further reduce transportation costs. But we are also on record as opposed to extravagant expenditures on passenger terminal stations. The recent history of the Pennsylvania and the New York Central companies shows what a threat to the financial standing of even the greatest companies such expenditures may become.

There has recently appeared a text-book, upon a subject which requires no laboratory or drafting-room work, written by a professor of engineering in one of our American colleges. In the preface to his book, the author, in recommending to teachers the method of laying out the work for their students, says

> While no two engineering schools present identical opportunity, yet the book is adaptable to various situations. For example, in the author's experience, with 32 one-hour recitations, *each presupposing two hours of preparation*, there was no difficulty in covering practically the entire book.

After reading these sentences, especially the phrase we have italicized, we were tempted to wonder if we had not reached somewhere near the bottom of some of the prevalent opposition to several of the present methods in technical instruction. The subject which the author is presenting is one of interest to engineering students, but by no means among the most important which he is called upon to study, and yet the professor considers that for each hour that the student appears in the class-room he should put in two hours of home study. Now, the minimum requirements in most of our technical schools are 15 hours a week of actual recitation period, and the maximum will sometimes run to ten hours more than that. Assuming only the minimum, then, under the professor's mild expectation, the student would have to stay in his study about 4½ hours a day for seven days in the week or, if he has any activities which demand either a Saturday or Sunday off, he can put in five hours study on each of the remaining six days. This is for the comparatively lazy man who is cutting his work down to the irreducible minimum. For the man whose class-room work runs to the normal 18 or 20 hours a week, we can hardly see where proper allowances for eating, sleeping and a modicum of exercise can be made, when the added 15 to 20 hours of drafting-room and laboratory work are also accounted for.

In reality we doubt if the professor would suggest a two to one ratio of study to recitation for any but his own subject; but to the student who may have to deal with a number of professors each holding this view the effect is the same. If the professor recalls his own student days, or if he has been at all observant of the students under him, he surely must realize the unreasonableness of his demand, in which case we fail to see the necessity for its inclusion in his preface. If he does not see this unreasonableness, we would hesitate to recommend him as an instructor of youth. The particular Jacks that will come under his charge will be very apt to become dull boys.

The ubiquitous house-fly is undoubtedly both a general nuisance and a specific means of spreading some infectious diseases, but it is receiving altogether more blame of late as a sanitary evil than is warranted by the evidence yet available. Thus only last week, at the convention of the American Society of Municipal Improvements, the author of a committee report on garbage and street cleaning, placed unwarranted responsibility upon the fly as a means of disseminating disease. Fortunately, the matter was set right in the course of the discussion, as may be seen from our account of the convention published elsewhere in this issue.

A few weeks earlier a paper entitled "The Emancipation of the Garbage Can," was presented before the meeting of the American Public Health Association. As may be seen from a condensation of the paper, published in another part of this issue, the author advances as an argument for tying garbage up in neat parcels before depositing it in the garbage can that by this means putrefaction and the breeding of flies will be prevented.

If householders can be induced to go to the trouble of draining garbage and wrapping it up in neat parcels before depositing it in garbage cans, well and good, but that this will have any material effect one way or another upon the health of a community, we seriously question. The gospel of cleanliness is well worth preaching, but to what extent municipal health departments are justified in this sort of evangelism until they have well in hand the unquestioned sources of communicable diseases is a subject for serious consideration. If the wrapping of garbage in paper, as proposed, entailed any additional expense upon the municipal treasury, we should be inclined to say that in the present state of sanitation the practice is not at all worth while. Since, however, it may actually save some of the municipal funds, through making it easier for garbage collectors to handle the cans and at the same time does aid in reducing the garbage-can nuisance, the practice seems commendable where householders can be induced to adopt it without too much friction. In some communities we are of the opinion that such a requirement would meet with so much opposi-

tion that it would do more harm than good through weakening the efforts of the health department in various lines of activity which really have very direct bearing upon the public health.

It is only fair to the advocate of garbage wrapping to say that he claims nothing for it except the reduction of nuisance and the convenience and comfort of the garbage collectors, except that he does urge that wrapping the garbage will prevent or lessen the breeding of flies. We fail to see how. Dr. Hall assumes the cans will be kept covered in any event and that, although wrapped garbage need not be collected so often as unwrapped, he proposes nothing less often than a weekly collection. Between covered cans and weekly collections how are flies to breed in garbage cans?

While we are on the subject, let us see the conclusions of one of the most sane and successful of our American health officers on the fly question. After an examination of numerous authorities, Dr. Chas. V. Chapin, of Providence, R. I., in "Sources and Modes of Infection" (see review in our Engineering Literature Supplement for Oct. 13, 1910), says:

> It appears that effective scavenging is the most important means of getting rid of flies. If yards, streets and vacant lots were kept clean, market refuse removed promptly, and all garbage kept covered, there would be an enormous reduction in the number of flies about dwellings. The most practicable way to prevent the breeding of flies in stable manure is to compel its removal once a week. Wherever it is possible the privy vault should be abolished. When this is impossible, the fly-proof privy has been urged. To the writer this scarcely seems feasible, but Levy in Richmond is making a strong fight for it, and his efforts will be watched with interest.
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> It is probable that under certain conditions, as in military and civil camps, and in filthy communities without sewerage, insects, especially flies, may be an important factor in the spread of the fecal-borne diseases, but there is no evidence that in the average city the house fly is a factor of great moment in the dissemination of disease.

Neither in this summary of conclusions nor elsewhere in his review of the subject does Dr. Chapin lay any stress upon garbage as a means of spreading disease, through the agency of the fly or otherwise. What he says about garbage gives no reason for thinking that wrapping or leaving garbage unwrapped has any bearing upon its relation to fly breeding. The essential points are to keep the garbage from being scattered about yards and to keep the garbage cans covered. Even these precautions, presumably, are desirable chiefly because garbage, as handled in any reasonably well-kept city, attracts flies about the houses rather than affords a breeding place for those troublesome insects.

The net conclusion of the whole matter is that we need more scientific knowledge and less repetitious babble of sentiment in dealing with flies or any other nuisance, and also clear-cut distinctions between public nuisances that are mere offensive odors and those that vitally affect or threaten the health of the people.

The responsible city officials of New York City are engaged just now in the very laudable task of framing a new budget which will not exceed that of last year. The standard thus set is the startling total of $163,130,270. To throw light on the general subject of increases in municipal expenditure that admirable volunteer organization known as the New York Bureau of Municipal Research has compiled a list of comparative percentage increases of population, property values, and total and departmental budget items between 1900 and 1910, as follows:

	Increase, per cent.
Population	38.68
Property values	72.23
Total Budget	79.69
Health Department	160.32
Law Department	110.98
Charities Department	101.63
Finance Department	99.56
Education Department	95.82
Park Department	83.60
Fire Department	68.43
Correction Department	66.67
Street Cleaning Department	49.69
Tax and Assessment Department	47.59
Police Department	33.39

These figures suggest much in the way of comment, particularly as to why the increases in departmental allotments should fall in just the order shown, and why the health department should show an increase four times as great as the growth in population and twice that of the whole budget, while the police department increase should be well under the population increase and not even half of the gross budget increase.

Obviously, without explanatory details the bare increases have little value—and the Bureau of Municipal Research would be the last to claim that they have. Fortunately for the citizens of New York an attempt has been made for a few years past to supply these and other details needed for an intelligent study of the budget or annual appropriation bill of New York City. This effort has taken various shapes, including, at least for some departments, vast masses of financial and other statistics. Since even the citizen of extraordinary acumen and intelligence can scarcely find the time, even if he have the ability, to cope with these huge tabulations there is now being held for the second or third time a "Budget Exhibit," with the object of bringing home, to everybody sufficiently interested to attend these shows, both city needs and budget attempts to meet them. The exhibits undoubtedly serve a useful purpose. At the same time, most of them are more spectacular and stimulative of interest and questioning than they are productive of scientific enlightenment as to why city expenditures grow so fast and why so much faster in some departments than others—unless it be through out-and-out-extravagance.

What is really and greatly needed to explain the whys and wherefores and to support or condemn the reasonable or unreasonableness of city state and national expenditures in their relation to growth in population and wealth is a scientific method of comparing unit costs with unit results therefrom—department with department, year with year, city with city, or state with state. The whole problem is beset with complications and difficulties of various sorts. The fundamental basis for its solution is improved uniform accounts and statistics. The statistics must be both financial and physical and must be so compiled and utilized as to give a reasonable number of cost data. That is, we must first know exactly what we have built or bought, or achieved; then how much it cost, in total and in detail; and then we can at last begin to express and compare municipal expenditures in terms of benefits received.

What Does Cooperation in the Iron and Steel Industry Mean?

The Presidential address of Judge Gary, the head of the United States Steel Corporation, before the American Iron & Steel Institute, printed in this issue, is a remarkable document. Judge Gary says substantially: Here are we, the heads of the American iron and steel industry, brought together in an organization for mutual benefit. We cannot, of course, agree not to compete with each other. The law forbids it. The law, however, does not *compel* us to compete, so let us just be considerate of one another's interests. Let us use our influence to keep prices from soaring high, in times of scarcity or dropping into the cellar in times when orders are scarce. Let us make prices fair and reasonable to our customers and to our competitors. Let us hold out the olive branch to the foreign producers also and ask them to hold us in similar fraternal regard, so that they shall not ruinously compete with us nor we with them.

That is substantially the spirit of Judge Gary's remarks to the assembled heads of the iron and steel industry last week; and if there was dissent from these views on the part of those present, it found no expression in the discussion.

That Judge Gary is entirely sincere in the expression of his ideas on cooperation in the steel industry, there is no reason to doubt. It is well known that the policy of his company as a factor in the markets has been directly in accord with these ideas. Nor is there reason to doubt that the cooperation policy as directed by Judge Gary is likely to have a most important effect on the iron and steel markets.

Judge Gary quotes the Attorney-General of the United States as declaring that the Sherman Anti-Trust law, which makes illegal and punishable an agreement not to compete, does not *compel* competition. He might have gone further and said that no law can be framed to compel a man or a firm to compete in business with another. The reason is obvious. In order that competition shall really be competition it must be active, forceful, energetic. The law may prevent two rival producers of nails, for instance, from agreeing to keep out of each other's territory; but it cannot compel either of them to sell his agents where he does not choose.

So a half a dozen or a dozen heads of iron and steel works must not, formally or informally agree to limit their competition with each other; but if each of them independently concludes that the general interests of the iron and steel trade as well as of his own stockholders will be best subserved by a policy of steady prices, by refraining from cutting under competitors, or even by making products of ordinary quality instead of the best quality that the state of the art permits—if friendship and the study of "Gary on Cooperation" brings about such a result, all the anti-trust laws that could be written could not alter the situation.

It looks, therefore, as though the Institute were a bomb-proof machine, and a machine that will work.

On the other hand, it is doubtful whether it will work quite so perfectly as might be supposed at first from a cursory reading of Judge Gary's address. It sounds beautifully to say that all prices should be fair and reasonable; but what are fair and reasonable prices for finished iron and steel? Will the same standard apply that has been established for public utility companies? Fair and reasonable railway rates for example are such as pay the cost of running the railway and leave a fair rate of return on the capital actually invested. Suppose the Steel Corporation were to adopt the same standard and fix such prices for iron and steel as would pay the cost of production plus a fair rate of profit on the capital actually invested in its mills and mines and furnaces, or, in other words, the cost of replacing its present plant. We doubt whether such a proposition would be exactly pleasing to the stockholders in Mr. Gary's huge corporation.

Nevertheless that standard is the one that ought to obtain if the really stable conditions which Mr. Gary holds up as ideal are to be attained, and if the consumers are to be given that fair treatment which Mr. Gary advocates.

It is told of Mr. Carnegie that he was once asked why at a time of depression in the iron trade, he was building new blast furnaces in Pittsburg. "All I'm afraid of," said the shrewd iron master, "is that I won't get them done in time so that they will pay for themselves next year."

There is a great deal of wisdom in a nutshell in that remark. The value of the annual output from a modern iron or steel plant is so great in proportion to the cost of the plant itself that even on moderate margins of profit or loss the plant is likely to be either very profitable or ruinous to its owner. Further, the advantage of the first-class plant in a good location over the second-rate plant in a poor location is so great that the former will pay handsomely when the latter will have to shut down.

It follows, therefore, that what is a fair and reasonable price for the product of one factory would leave a badly located or badly managed rival in straits. The question comes, therefore, by which standard would Mr. Gary fix his fair and reasonable selling price? Would the fraternal feeling which he is so seduously cultivating in the steel industry lead to setting prices so high as to allow a fair profit for the "scrap heaps" in the industry? If not, then the owners of the scrap heaps will feel that they are being unfairly treated. On the other hand, with prices set at so high a scale as this, will not the poor worm of a consumer finally turn? Will not some other fellow or a dozen or fifty other fellows who know the iron business and who see the chances for large profits start new plants which

...ay set prices considerably below the fraternal ...ale?

And still again; would that world-wide har...ony and cooperation among steel producers ...hich Judge Gary holds up as ideal be quite so ...al from the "ultimate consumer's," stand...int? Of course, Judge Gary stipulates that ...ices are to be fair and reasonable to the con...mer; but is the consumer—is the public, which ...s to pay the bill, ready quite yet to accept the ...eel manufacturer as the sole arbiter as to what ...rices are fair and reasonable? Of course, the ...ublic has to accept the situation at present. It ...as to swallow the pill whether it likes it or ...ot; but we suspect that it does not like the ...aste any better than at first. There are even ...igns that the stupid public is so illogical as to ...hink that there may be some connection between ...he increase in the cost of living and the extent ...o which the prices of staple articles are under ...he control of producers and not regulated by ...competition.

We wonder, indeed, whether Judge Gary himself, if subjected to cross-questioning, might not admit some danger that the producers who fix these "fair and reasonable" prices might not at some time become so covetous as to favor their own interests rather than those of the buyer. Would Judge Gary when on the bench submit a case to a referee who was one of the parties in interest?

One of the most conservative of publications, the New York "Journal of Commerce" comments on Mr. Gary's cooperation scheme as follows:

> It is somewhat unfortunate that the first president of the American Iron and Steel Institute did not attempt some definition of the significance of his favorite word "cooperation." If it means a combination among producers to fix prices without regard to the ordinary laws of supply and demand, it expresses what is probably the most dangerous tendency in all industrial and commercial life. To attempt to reach a world-wide understanding among the producers of iron and steel with a view primarily to the protection of what they conceive to be their own interests would be the prelude to quite a different kind of "cooperation" in the government of the nations of the world from that which Judge Gary has in mind.
>
> The moment that it is found to be possible to establish a perfect monopoly of production or of distribution, or of both, in this basic department of human industry, the people at large will be prepared to take the job off the hands of the ingenious gentlemen who will have succeeded in paralyzing competition and syndicating the one branch of manufacture which underlies all the rest. In other words, the era of State socialism will be upon us, and Judge Gary and his friends will be promptly allotted such compensation as that to which the powers that be of a social democracy may think they are entitled.

We would offer another suggestion. It is now a well established principle of law that where competition is destroyed—where a monopoly, natural or artificial, is established—the government may interfere for the protection of the public, by fixing rates or otherwise.

Difficult and objectionable as such interference would be, no one familiar with the current of public thought at present can doubt that it would take place. This is one of the reasons why we hope, in the public interest and in the interests of the iron and steel industry, that the Gary policy of cooperation may not be carried to its logical conclusion.

Adjusting Telephone Rates to Cost of Service.

The revision of telephone rates in Boston and the surrounding suburban districts, to place them upon an equitable basis so that the charges represent the cost of rendering the service plus a reasonable profit seems about to be accomplished. After nearly four years of deliberation and investigation, the Massachusetts Highway Commission, charged by law with this duty of supervising telephone traffic, has issued a series of recommendations to the New England Telephone & Telegraph Co., operating the telephone facilities in this district. The recommendations closely follow the findings of the Commission's engineers and accountants, as discussed in another part of this issue.

The trouble with the service in and about Boston which these recommendations are designed to remove are more accentuated, perhaps, than in any other similar metropolitan district about the country. It is believed that (1) the area within which a subscriber has unlimited service, (2) the number of central exchanges to which he has connection without toll charge and (3) the entire extent of service given without charge beyond that covered by one single fixed rate, are all of them unparalleled in this country or elsewhere.

A telephone patron in the Boston metropolitan and suburban district who holds what is known as an unlimited contract has free connection to some 15,000 telephones within this territory of 436 sq. mi., including all of Boston and some 40 surrounding towns and cities. This condition has been possible, together with continued prosperity of the telephone company, only by making some of the smaller telephone users pay more than an equitable charge to support the unlimited-service contracts. The average resulting prices per message to all the various classes of subscribers were found to range from 2 to 8 cts. The average price per message for all these classes (exclusive of interior calls in private-branch services) has been shown to be 3.46 cts. The result has been that 73% of the unlimited subscribers in the Boston metropolitan district, and 64% of the same class in the suburban district were getting service at a figure much lower than the average price per message.

Toll charges for calls to points from 1½ to 15 miles from the center of Boston were the same, in spite of the very obvious fact that such toll charges should be more nearly proportional to the mileage above a certain amount representing the cost of making the connection irrespective of distance.

The recommendations of the Highway Commission are expected to go into effect about Nov. 1, and it is perhaps surprising to find so little opposition to such a radical change as has been proposed. The telephone company seems to fall in with the Commission's suggestions, and for the most part the public is accepting the increases and reductions in rates quite philosophically. The gross income of the telephone company, it is expected and intended, will be reduced at first about $400,000, so it is evident that the change over all the territory involved will be generally in the interest of the subscribers' pocketbooks. A few of the suburban subscribers whose rates will go up have held indignation meetings to condemn the new rates, and have even gone so far as to demand that the Highway Commission itself be abolished. The Boston Chamber of Commerce, however, through its directors, has voted its approval of the principles involved, although it is probable that the majority of the members of this body are in the unlimited class of subscribers whose rates must go up very materially.

Possibly the conditions which have been found to exist in and around Boston may also be found to a greater or less extent in the several metropolitan and suburban districts of the country and, if such is the case, the principles involved may be applied in much the same way for much the same ends. However, too complete parallels must not be drawn between these other metropolitan districts and the one in Massachusetts under consideration. It is possible that the very ends sought by the Massachusetts revision may be found already existing in the other districts to a greater or less extent in local telephone practice. At any rate, it is certain that the end sought for by the Massachusetts revision is a rational application of the practice in isolated communities to a group of communities geographically close but whose interests are largely self-centered, although in addition considerably tied to a common center—Boston.

There seems to have been a greater hesitancy among engineers to attack the problem of the regulation of telephone traffic and rates than is seen in the case of electricity, gas and water-supplies, street railways, etc. This probably and in part is because of general knowledge that telephone service hinges upon a series of small operations and involves countless pieces of almost minute apparatus, with which an engineer, without special training, cannot hope to be wholly familiar. The situation is further complicated by the inter-relations of investment and depreciation with the amount of the service demanded by the subscriber and by the known increase in unit cost of service when the exchange grows beyond a certain point. A careful survey is further made difficult by the extra labor of measured service, by the demand for flat rates, and, lastly, by the individuality of each subscriber and his needs. Hesitancy to demand the close regulation of telephone traffic may also be attributed in part to a generally reasonable and courteous treatment of subscribers, and to a feeling that the business was being conducted on a fairer financial basis than some other public utilities.

While it is seen that the attack of the problem in Massachusetts follows only well accepted principles and well recognized procedure for public-utility supervision, yet it may be well to point out some definite steps which were necessary in approaching the problem. From an examination of the reports reviewed elsewhere in this issue, one may gather the ideas (1) that existing rates may be studied, (2) that their appropriateness or inappropriateness may be realized, and (3) that remedies may be recommended by an engineer having only experience and ability in the study of public service problems, if a reasonable cooperation can be secured from the company furnishing the telephone service. It seems to be necessary to rely on highly specialized telephone engineers in determining the cost and depreciations of much of the apparatus found in the modern telephone system, especially in the central exchange to which all the subscribers' lines are led. Such telephone engineers for the most part are connected with the telephone companies so that over-cautious public-service commissioners may feel that there is insurmountable difficulty in obtaining such figures that will be reliable. The experience in Boston may dissipate such fears for the present if only the temper there displayed may mark similar investigations everywhere.

The Massachusetts investigation, with its clearly defined procedure, seems to be a type of study of the regulation of telephone traffic and rates which promises to be widely adopted as the demand for this particular regulation spreads with the demand for the regulation of other public utilities.

First, it appears that a detailed appraisal of property and comprehensive traffic reports are necessary for the study of investment apportionment between local and toll-line service and between "readiness-to-serve" and "service-rendered" apparatus for the different classes into which the subscribers are to be segregated. Secondly, geographical zones seem to be desirable, following the principle that an area within which a given rate applies should be a district comprising so far as is possible a group of neighboring subscribers, rather than a large area across the wide stretch of which the majority of subscribers do not call for frequent service. By allowing connections between subscribers in contiguous zones without toll charges (called "overlapping"), communication between real neighbors is unhampered and toll service between non-neighbors is more equitably adjusted to actual cost of service. By such a segregation, the company may secure its compensation for service between the more distant points in an extended territory from those who get the service, rather than from those who use merely local service involving a much smaller portion of the whole plant.

Thirdly, the grouping of subscribers into service classes must be rather closely adhered to within each zone, so that when one subscriber's demands greatly exceed the average of the class he has selected it will be cheaper for him to choose a higher-rate class. The "investment-charge" and "traffic-cost" divisions of plant for each class are to be arranged for the average subscriber of this class.

Beyond making each flat-rate subscriber pay for the average service in his class it seems inadvisable to go with flat rates. Then the smaller users in a given class pay for some of the traffic of the heavier users. If flat rates are so restricted they do not interfere with measured service for the smallest users, and each class being self-support-

ing, so to speak, one class does not burden another.

Finally, the imposition of proportionately higher rates for city telephones than for rural telephones for a given high grade of service has been here justified because of the unnecessarily high quality of service imposed upon the entire commonwealth by the needs of the metropolitan and suburban districts.

The whole investigation in Massachusetts shows what can be done by constructive cooperation between a public-service commission and a public-utility corporation. The telephone company, in this case, has largely borne the expense of the whole investigation and revision, amounting probably to from $60,000 to $90,000, and it has given ready aid to the Commission's engineers throughout the four years occupied. The Commission, on the other hand, seems to have met the advances of the company in a spirit of commendable open-mindedness. Such a progressive and broad-minded policy has made possible one of the most radical changes ever made in the conduct of any public utility, almost without friction and entirely without bitter feelings.

LETTERS TO THE EDITOR.

Still More of Western Views on Conservation.

Sir: A careful reading of Mr. Johnston's letter published in your issue of Sept. 22 puts me in mind of the Scotchman who "was perfectly open to conviction but would like to see the man who could convince him." This being the case it seemed hardly worth while to burden your pages with an answer. His letter of Oct. 6 should not go unanswered because it assumes situations that are not in accordance with the facts.

When Mr. Johnston says "we of the West are in darkness" he speaks only for those holding his views, and ignores the existence of many to whom "Conservation" does mean something and who are willing to see the old order changed, even at a temporary cost to themselves. Those for whom I would speak live this side of the Rockies; come in contact with the Forest Bureaus, pay grazing fees, and yet do not revile the "New Nationalism." Moreover, if Mr. Johnston cares to get away from glittering generalities and be specific his arguments will not go unanswered.

Mr. Johnston makes fair discussion hard by implying things that have no existence out of prejudicial imaginings. Will he please tell us who has ever advocated that our "national heritage should be locked up for the benefit of unborn generations"? In what respect is the West less "open for the stronger sons of the East"? The good citizens can "support a home" now as before, and they are coming out here in ever increasing numbers and seem to like it.

Mr. Johnston says part of the white race "desires to restrict settlement." Even if that were so, why not? Mr. Johnston says he believes the public domain is a national heritage, and if so does he believe in minority rule? The census estimate of 1906 makes the total population of the States of Idaho, Montana, Nevada, Utah and Wyoming less than the combined population of Pittsburg and Boston, and less than 1½% of the population of the United States. To turn over the control of the board of directors to 1½% of the stock of a company would be considered an absurd proposition.

Supposing all this "Conservation" business does not work out to our liking, does that warrant wholesale condemnation? We expect criticism to run rife with the demagogue and the political strap-hanger, but an engineer ought not to pull down except as he can build better. All thoughtful men recognize that this country is in a state of momentous transition, and if we are not to run amuck cool heads and unselfish effort are absolutely necessary. And as we feel our way upward many mistakes will be made and temporary harm will be done, but those of us who still have faith that the world is growing better feel that little is accomplished by sitting down and wailing because things are not as in the "good old days" or because the new shoe pinches.

Very respectfully,
Geo. M. Bacon, M. Am. Soc. C. E.

Salt Lake City, Utah, Oct. 11, 1910.

An Interlocking Sheet Pile Cofferdam for Raising the "Maine."

Sir: Referring to the various schemes proposed for the raising of the "Maine," it is not easy to see why such very expensive methods as have been suggested are necessary, either in the way of building great stationary docks or rigging up floating machinery for bodily hoisting the hull from the water. Either of these methods are objectionable, firstly, because of their great expense and the difficult diving work and hoisting involved, with a vessel so broken and submerged in mud; and, secondly, because of the danger of so disturbing the physical condition of the boat and its contents that it would not be sure to furnish the historical evidence of the causes and effect of the disaster, which is so important from a national and an international point of view.

It would seem from a casual view of the subject that the obvious method of treating this problem would be to build a cofferdam entirely around the ship, afterwards pumping out the water and digging or dredging out the mud surrounding her until a complete examination could be made of her present exact condition, undisturbed. It would then be easy to break her up wholly or in part or else to repair her so that she could be floated. It would seem to an outsider that such a cofferdam could be quickly and cheaply built by driving a continuous row of steel piles with interlocking edges, several forms of which have been devised for such work on a smaller scale. These would be of some general form resembling I-beams or channel beams with the edges so formed as to hook together, each pile sliding down in mesh with the edge of the last one driven and securely locked thereto through its descent. The whole structure being of an approximately elliptical form, would act as a series of arches to resist the outward pressure of water or mud. The piles could also be braced at the top, if necessary, by lateral trussed work, as fast as they were driven.

Such a structure would of course have the advantage of a large percentage of salvage, as it could all be pulled up and used again somewhere else. If steel "shapes" of appropriate design and sufficient strength cannot be procured in open market it would not be difficult to design and have rolled to order something large and strong enough.

It may be that owing to ignorance of the exact conditions present I am suggesting impracticable methods. If so, I should be glad to be informed just why this system, or some modification of it, should not be a happy solution of the problem.

Very truly yours,
Oberlin Smith.

Bridgeton, N. J., Oct. 7, 1910.

[It is interesting to note that about a week after we received the above letter, press reports announced that the Board of U. S. Army Engineers appointed to investigate the raising of the "Maine" had decided to utilize the interlocking pile cofferdam, approximately as outlined by Mr. Smith. The details of the scheme are given on p. 424 of this issue.—Ed.]

Notes and Queries.

In "Formulas for Use in Detailing Steel Structures," Eng. News, Sept. 1, 1910, pp. 224-226, an error is reported by the author, Mr. Hart Vance. Near the bottom of the middle column on p. 225, the calculation for angles A and B is stated to give tan A and tan B, whereas the logs given are those of cot A and cot B. The angles are given correctly, however.

We published in our issues of Sept 23, 1909, and May 5, 1910, maps showing the peculiar shape of the city of Los Angeles since its ambition to become a seaport led it to annex first a long narrow strip of land leading to the ocean and then several towns bordering on the ocean. The Security Savings Bank of Los Angeles has issued a folder showing on nine successive pages the way the city has grown and altered in shape from the original area six miles square. The maps are drawn from the official records and are more accurate and detailed than the one which we published. The folder also shows a map of the Los Angeles Aqueduct, now under construction, and a map of Los Angeles Harbor.

The First Formal Meeting of the American Iron & Steel Institute.

The first formal meeting for the reading of papers of the American Iron & Steel Institute was held at the Waldorf-Astoria Hotel, New York City, on Friday, Oct. 14. Nearly 200 were in attendance, including the chief officers of nearly all the important iron and steel producing concerns in the United States. There were also present as guests nearly 30 officers of European iron and steel companies.

At the opening of the meeting, the Presidential address was delivered by the Institute's President, Mr. Elbert H. Gary, Chairman of the Board of Directors, United States Steel Corporation. Mr. Gary's address set forth the aims and purposes of the Institute, referring especially to the need for co-operation among iron and steel producers for the maintenance of prices on a stable basis, free from sudden and large fluctuations. Mr. Gary's address is re[printed] in full elsewhere in this issue.

The address was followed by a paper [by] Mr. James A. Farrell, President of the United [States] Steel Products Export Co., on "Foreign [Rela]tions." The general subject of Mr. F[arrell's] paper was the possibility of harmoni[ous co]operation between American and foreig[n iron] and steel interests for their mutual ben[efit.] It practically carried into further detail th[e ideas] set forth in Mr. Gary's address. Mr. F[arrell's] paper was read by Mr. E. C. Felton, Pr[esident] of the Pennsylvania Steel Co., who later [took] part in its discussion. Further discussion[s were] also presented by Mr. George W. Perkins, of J. P. Morgan & Co., Herr E. Schaltenbrand, Chairman of the Stahlwerksverband Aktiengesellschaft, and Mr. E. A. S. Clarke, President of the Lackawanna Steel Co. All those who took part in the discussion expressed their appreciation of and agreement with Mr. Farrell's views.

The next paper presented was by Mr. William B. Dickson, First Vice-President, U. S. Steel Corporation, entitled, "The Betterment of Labor Conditions in the Steel Industry." Mr. Dickson has taken a special interest in and has been largely responsible for the notable work undertaken in recent years by the Steel Corporation and its subsidiary companies for the protection of employees from accident and the relief of those suffering from accident and those dependent upon them. Mr. Dickson urged that in the pending legislation for radical alterations in employers' liability laws, manufacturers should use their influence as good citizens to the end that such legislation should be properly framed so as to be just and fair to all interests concerned. He remarked that it was easier and wiser to help steer an automobile than to blindly stand in its way and be run down. We hope to present Mr. Dickson's paper in our next issue.

After a recess for luncheon Mr. Dickson's paper was discussed by Mr. Charles Kirchhoff, Mr. Edgar S. Cook, President of the Warwick Iron Co., and Mr. Edward Bailey, President of the Central Iron & Steel Co. of Harrisburg.

Following this, Mr. Charles Kirchhoff read a paper on the "International Metallurgical Congress of 1910," held in June at Düsseldorf, Germany. Mr. Kirchhoff gave an excellent summary of the principal technical features of the Congress. His paper was discussed by Herr Schaltenbrand, who was President of the Düsseldorf Congress, and by Prof. Henry M. Howe, of Columbia University.

The final paper on the program was by Mr. Willis L. King, Vice-President of the Jones & Laughlin Steel Co., and had the title, "Contract Obligations." Mr. King referred particularly to the practice which has grown up in the steel trade of permitting a purchaser who has contracted for a certain tonnage of steel to cancel a part of his order or have the price altered in case market changes occur to his detriment after the contract is made. Mr. King urged that contracts of sale should be equally binding upon seller and buyer, and expressed his belief that proper co-operation among the principal iron and steel interests would eliminate the present practice, which he branded as highly detrimental and unfair to the producers.

Mr. King's paper was discussed by Mr. Charles M. Schwab, President of the Bethlehem Steel Co., Mr. J. A. Topping, Chairman of the Republic Iron & Steel Co., Mr. Charles S. Price, President of the Cambria Steel Co., Mr. H. P. Bope, First Vice-President of the Carnegie Steel Co., and Mr. E. J. Buffington, President of the Illinois Steel Co. All of these gentlemen expressed general accord with Mr. King's proposals. This concluded the day's program.

In the evening a banquet was held in the grand ball-room of the Waldorf at 7:30 p. m. On Saturday the members and guests spent the day in an excursion to the principal points of interest in New York Harbor. On Sunday evening, Oct. 16, a special Pullman train, with compartment cars, left the Grand Central Station with about fifty members of the Institute and their foreign guests, and the present week has been spent in a tour taking in the princip[al]

...and-steel-producing centers. According to ... published itinerary, Monday was to be spent ... Buffalo visiting the Lackawanna Steel Co.'s ..., the navigation improvements at Black ... and the scenery and industrial plants at Niagara Falls. Tuesday and Wednesday were ... be spent in Chicago, the first day being de... to the plant at Gary and the South Chi... Works of the Illinois Steel Co. The pro... for Wednesday included the McCormick ... of the International Harvester Co., the ... Yards and the Pullman Works. Thurs... and Friday were to be spent in Pittsburg. ... program for the first day included a trip ... the Monongahela River with a visit to the ... & Laughlin South Side Works, and the ... Homestead Works of the Carnegie Steel Co. ... Friday morning the Carnegie Institute li..., music hall and technical schools were ... occupy the forenoon, and a visit to the West... Electric works at East Pittsburg the ...ternoon. Saturday was to be spent in Wash...ton, the program including a tour of the ..., reception by President Taft at 11 a. m., ... visits to the Bureau of Standards, Rock ... Park and the Soldiers' Home.

Cooperation in the Iron and Steel Industry; Presidential Address Before the American Iron and Steel Institute.

By Hon. ELBERT H. GARY.*

At this first formal meeting of the American Iron & Steel Institute it is my privilege, and no less my pleasure, to felicitate the members on the success which has already been reached as the result of an earnest and untiring effort on the part of each to engender a feeling of affection amongst the members and to promote the welfare of the Institute regardless of any personal or selfish interest. The disposition you have shown, if maintained, will result in benefits that cannot at this time be measured.

Especially are we to be congratulated that so many from foreign countries are with us. We realize that these visitors are men of important affairs, and have in their charge and control properties and business of great magnitude which they could not leave even for a short time without considerable sacrifice. We understand they are here to evidence a desire, so far as practicable, to work with us in the endeavor to better the conditions of all.

In behalf of the Institute I bid these foreign gentlemen thrice welcome. We are delighted with their presence; and we are proud of their acquaintance. We offer to them our congratulations for their achievements in their own respective countries, personally and as representatives of large aggregations of wealth and business. With no spirit of envy do we read of their prosperity. For many years we have been learning from them, adopting their discoveries and their methods. It shall ever be our aim to cooperate with them in placing and keeping upon a better basis the lines of business in which we are engaged, and in cementing the friendship which exists and which we hope may be permanent, not only as between them and ourselves, but as between their countries and our country. Before their departure we hope to give to them proofs of the sincerity of our professions of esteem.

The production of iron ore in the United States and Canada, during the year 1880, using in all cases round numbers, amounted to 7,000,000 tons.

	Tons.
In 1890	16,000,000
In 1900	27,500,000
In 1909	53,000,000
PIG IRON:	
In 1880	4,000,000
In 1890	9,000,000
In 1900	14,000,000
In 1909	26,500,000
STEEL:	
In 1880	1,250,000
In 1890	4,300,000
In 1900	10,000,000
In 1909	25,000,000

The increases in the production of steel did not correspond with the increase in the production of pig iron for the obvious reason that a good deal of scrap was melted, and, therefore, iron was used the second time.

The production of coke amounted to:

	Tons.
In 1880	3,500,000
In 1890	11,500,000
In 1900	20,500,000
In 1909	41,000,000

If the ratio of increase during the next 20 years should be the same in each decade over production at the close of the preceding decade as that which took place in the 10 years from 1900 to 1909, there would be produced of:

	Tons.
IRON ORE:	
In 1920	102,000,000
In 1930	197,000,000
PIG IRON:	
In 1920	50,000,000
In 1930	94,500,000
STEEL:	
In 1920	62,500,000
In 1930	156,000,000
COKE:	
In 1920	82,000,000
In 1930	165,000,000

As the figures given commence from a low basis in 1880 it is probable the ratio of increases for the next twenty years is not justified. However, if the increase in tonnage during that period shall be the same in each decade over the production at the close of the preceding decade as that which took place in the ten years from 1900 to 1909, inclusive, then and on that basis the production would be of:

	Tons.
IRON ORE:	
In 1920	78,500,000
In 1930	104,000,000
PIG IRON:	
In 1920	39,000,000
In 1930	51,300,000
STEEL:	
In 1920	40,000,000
In 1930	55,000,000
COKE:	
In 1920	61,500,000
In 1930	82,000,000

Reference has been made to the magnitude and growth of the iron and steel industry of America, as evidenced by these figures, for the purpose of emphasizing the importance and the opportunities of the American Iron and Steel Institute, and the necessity for its existence.

There have been for some time other associations which were calculated to develop and improve the iron and steel industry by the accumulation and distribution of statistics, or by the study and discussion of numerous technical questions, and these associations have been very successful and satisfactory; but it has been felt they were not, in practice at least, of sufficient scope and breadth to fully cover all the necessities of those who are engaged in, or connected with, the iron and steel trade.

Due credit has been, and will be, given to those organizations; and there is no disposition to antagonize, or interfere with, or detract from, any of them. On the contrary, we hope, directly or indirectly, to affiliate with them and assist in the good work in which they are engaged.

It seemed to the great army of individuals who have been particularly interested in successfully conducting this branch of industry that they had not prior to the formation of this Institute a common meeting place where it would be appropriate to consider any and all of the important questions which apply to their lines of activity. In some respects at least methods had heretofore been unsatisfactory. Each individual was to some extent managing his affairs without regard to the rights or interests of others. The results are well known, and have been so frequently referred to as to make it unnecessary to dwell upon them at this time. That it was essential to do something to change and improve these conditions we all insist.

And so this Institution was created upon a basis so broad that there is no limit to the good which may be accomplished. Its object is to afford means of communication between members of the iron and steel trades upon matters bearing upon their business affairs. Of course, this does not mean the undue advancement of the claims of any member to the prejudice of other members or of any one outside.

As stated by many of you during the period of formation of the Institute, it is intended that ethical questions shall be considered as important as economic or scientific questions. The rights and duties of each member, so far as his conduct relating to this particular department of industry is concerned, and within the lines of propriety, should always be matters for the deliberation of the whole membership of the Institute. The level occupied by the Institute is high, and its management must always be above reproach; and in all the questions which may properly be considered by the Institute the pecuniary interests and the honor of each member are alike involved.

These general references are made because they are in accordance with the pronounced opinions of the charter members, and should be emphasized at the outset.

Primarily the Institute was organized, and should be conducted, for the benefit of its members. It should result in decided pecuniary advantage to all. The opportunities for presentation and discussion of economic or scientific questions are likely to give all a clearer understanding of all the facts and circumstances applicable to the management of the factories, and furnaces, and mills, and their connections, so that every one possessed of the necessary knowledge may deal with reference to the rights of all concerned.

Also, the consideration and discussion of ethical questions particularly affecting those outside of the membership but connected with or interested in the conduct of their affairs, should be deemed just as essential and should result in material benefit to all.

There are many subjects of importance in which as members of the Institute we are concerned, and they should be discussed; but a few only can be referred to in this address.

One of the most important business matters at this time, and perhaps at all times, is the maintenance of stable conditions in the iron and steel industry; and to this is attached the question of prices. For periods, at least, in the past, unsatisfactory conditions have been the rule and not the exception. Violent, sudden and wide fluctuations in prices have occurred, and they have been detrimental to every one connected with the business, and to the public generally. The steel and iron industry, more or less recognized as the barometer of trade, has had an influence on general conditions for good or bad, and much of the time for bad.

We do not, and never have, advocated fixed unchangeable prices. If they are unreasonably high they should be lowered; and vice versa. If for any good reason at any time we are convinced that the rights and interests of ourselves, our employes, or our customers, demand decreases in selling prices, or the readjustment of prices, we should be prompt to make them. This does not, however, militate against the general proposition in favor of stability as opposed to demoralization. We know, as a matter of fact, from most careful observation and an abundance of testimony from those directly affected that the maintenance of fair prices and the prevention of sudden and wide fluctuations is desired by our customers themselves.

If you suggest that many members of this Institute are purchasers or consumers of the commodities produced by others and, therefore, may object to the position taken, the obvious answer is that they do not object. Many of them purchase with the view of converting or refining and selling the product. Many have stocks of materials on hand from time to time and cannot afford, and do not desire, to have the values of inventories reduced. Besides, consumers like to feel that they can depend upon prices which they pay being as low as the prices which their neighbors subsequently pay. We are all purchasers and consumers of one thing or another. We sell certain manufactured products; but we buy a greater variety of products; and we like to feel that we are at all times treated as our neighbors are treated.

If we go to the tailor, the butcher, the grocer, the farmer, the railroad company, the steamship line, the telegraph office, the newspaper office, or any others having for sale that which we need and buy, we are better satisfied if we are certain we are treated like our neighbors, and that there will be no sudden and material decreases immediately after we have bought and before we have had opportunity to consume the product which we have purchased.

It is pleasing to note that in much of the business transacted in this country, commercial, financial and industrial, there is a tendency towards an even, steady and continuing basis of action. It would be better for us all, and better for the country, if conditions in all departments of business were more stable and less likely to be disturbed by agitation, doubt or distrust.

It has sometimes been urged that an effort to maintain reasonable prices for iron and steel is contrary to the natural laws of trade; that it is opposed to the law of supply and demand. This we do not admit. We do not undertake nor advocate anything which is unreasonable, unnatural or unfair.

Those who oppose the maintenance of fair prices when the volume of business is low on the ground that it is contrary to the law of supply and demand, make the mistake of supposing that capacity to produce creates supply. The law of supply and demand means the quantity which one possesses and is willing to dispose of and the quality which another desires to possess and is willing to buy. Capacity to furnish does not create supply; nor does ability to purchase create demand.

It is just as illogical to say that because one is able to furnish a given quantity, that is evidence of the supply, as it would be to say that because another can use and has money to pay for a certain quantity, that constitutes a demand. The whole question should depend upon mutual consideration and decision. The seller should never take advantage of the necessities of the consumer to unreasonably advance prices, nor should advantage be taken of the necessities of the producer to secure his product at an unreasonably low price.

What then should the manufacturer do at times when the consumers or purchasers are not willing to pay the price demanded, however reasonable it may be? Many of us at least, believe he should reduce the output to meet the demand, much or little, and wait until those in need are willing to pay what is fair and right. Remember this assertion is based on the assumption that prices at all times must be fair and reasonable and subject to reductions or changes whenever it is decided they ought to be made. Such reductions, however, should be made only after due consideration, and in an orderly way and not as the result of panic.

On the other hand, if prices are at any time higher

*Chairman Board of Directors, U. S. Steel Corporation, 71 Broadway, New York City.

than they ought to be, the consumer, whatever his pecuniary ability to pay may be, should wait until the prices are reduced. If the attitude of both seller and purchaser should be as suggested, it would not be long before they would get together on a proper basis, especially if what we advocate shall be carried into actual effect. What has been said is outside of, and without reference to, any question of special privilege, or undue advantage, or improper control of any commodity which would enable the producer from motives of cupidity or otherwise to fix or maintain unreasonable prices, or to take advantage of the necessities of the consumer. The great aggregations of wealth make this question important; but it may not be appropriate to discuss the same at this time.

Now, how shall we bring about the conditions which have been suggested as ideal?

The existence of this Institute, and the large attendance on this occasion, furnish the answer.

Real, hearty, cheerful and continued cooperation on the part of the members will secure results which should be entirely satisfactory. Frank and friendly intercourse; full disclosure of his business by each to the others; recognition by all of the rights of each; a disposition to assist and benefit each other so far as practicable and proper; conduct founded on the belief that healthy competition is wiser and better than destructive competition; all these are desirable and necessary and will be effective.

Some of you may say that in your opinions, based on the past, a fair and just equilibrium cannot be maintained except as the result of some agreement on the part of those who are interested. It is a sufficient answer to make that you have no right to enter into such an agreement, express or implied; that the laws of this country are opposed to it.

But, as stated by the Attorney-General of the United States in his argument before the Supreme Court in the Standard Oil case, the law does not compel competition; it only prohibits an agreement not to compete. If competitors are in frequent communication and make full disclosure to each other in regard to their business, notifying one another of what they are doing, it will follow as a natural result that no one will take advantage of the information he thus receives to act unjustly or dishonorably towards his neighbor. You know by experience this is so; and it will become more certain as time goes by and each of us realizes more fully his obligations to others and to this Institute.

Cooperation is broadening in its application to specific subjects growing out of the activities of life. We see it in many lines of business outside of our own. We see it in this country, and in foreign countries. Especially have we observed it during the last few months in the consideration of some of the matters which have demanded the attention of the Interstate Commerce Commission and other official departments.

Cooperation can be, and should be extended to our business relations with foreign manufacturers and producers. They will meet us half way. Indeed, the presence at this meeting of so many distinguished and representative men from Great Britain, Germany, Austria, France and Belgium, respectively, is positive proof that they believe in this Institute, and are friendly to its members, and have high appreciation of the efforts we have been making in the direction of conciliation and cooperation.

Whenever and however we may have opportunity to meet these gentlemen and to legitimately cooperate with them in promoting and conserving their interests as well as our own, we should do so without hesitation. We must at all time evidence a disposition to reciprocate the friendship which these gentlemen have shown, and to demonstrate to their satisfaction that we believe thoroughly in the doctrine that we are more or less bound together by business connections, and that we enjoy prosperity when they enjoy it, and that we fail of success when they fail. Many who are present will live to see the time when the spirit of cooperation shall extend even to the government of the nations of the earth.

Again, there is no better way of advancing our own interests than to conduct ourselves in such a way as to make it certain we are endeavoring to promote the welfare of others with whom we come in contact. Uppermost in our minds should be the proper consideration of the rights of our employes. Members of this Institute represent corporations or firms who have in their employ hundreds of thousands of men. Many of these workmen are foreigners who are not familiar with our language or customs. Some of them have been poor and have had few advantages in their native countries, and may not be fully able to protect themselves.

Whether this be true or not we should make it certain that all are so treated that they have the opportunity to be well housed, and well fed, and well clothed. So far as we can we should lend our assistance to the improvement of the conditions of our workmen, and, of course, the wages paid should always be fair and reasonable. All of us have discovered since this Institute was formed that there were many things which we could do for the betterment of the conditions of the working-man; and we have been prompt to do them. Particularly have we made great strides towards safeguarding our employes against accidental injury.

A continuation of the efforts we have been making in this direction will result in securing a larger measure of confidence on their part, and will bring to us the consciousness that not only have we benefited ourselves pecuniarily, but what is more important, that we have done the right thing. Certain aspects of this subject will be presented in a special paper.

Also, we should extend the spirit of cooperation to our customers. We should be sure at all times that we are treating them right. If it is claimed on any occasion by a customer that our prices are too high with respect to any commodity, we should promptly take up with him the question for the purpose, and with the intention, of arriving at a just conclusion. In all cases we advocate the doctrine of cooperation as opposed to independent action. We have found, particularly during the last two or three years, that we are succeeding better as we are brought into closer relations with our customers, giving them our confidence and informing them frankly of our conditions and intentions.

I predict for the Institute a great future. We are ambitious to have it prosper, and shall not be disappointed. So long as we pursue the path we have marked out we shall merit and receive the approval of all who are acquainted with our work. The influence of the Institute for good will be pronounced, and as it is better established and thoroughly known, its opinions, as officially expressed on all matters which it may properly consider, will be respected.

For the honor you have conferred upon me personally in the election of your first President, and for the cordial support which you have extended without reserve, I thank you sincerely. For your confidence and friendship, I am profoundly grateful.

The Army Engineers' Report on Raising the "Maine."

Following the appropriation of $300,000 by Congress to be utilized in raising the wreck of the U. S. battleship "Maine" from Havana harbor, the Chief of Engineers, U. S. Army, appointed a board of army engineers to investigate the condition of the wreck and to report upon the best means to carry out the purposes of the appropriation bill. This board, of which Col. W. M. Black is chairman, made an intimate personal examination of the sunken hulk and of the bottom and weather conditions in the harbor, and examined in some detail all of the many schemes for raising the ship which were brought before it. As a result of its study, it recently submitted a report to the Chief of Engineers, Gen. W. H. Bixby, who, through the Secretary

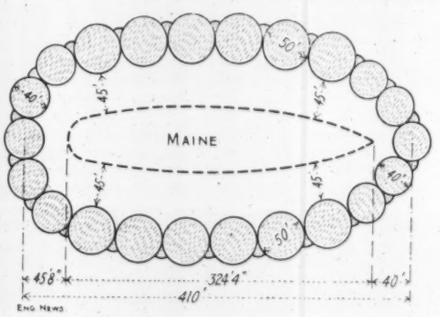


Fig. 1. Cofferdam of Steel Interlocking Sheet Piles to be Driven Around the "Maine."

of War, transmitted it to the President for approval. This report recommends that a steel interlocking sheet-pile cofferdam be built around the wreck, the interior pumped dry and the ship examined on the dry bottom so provided, its future disposition to be decided by its condition then ascertained. The plan has been approved by the President and work, under its provisions, is to be started as soon as orders for material can be filled.

We have received from the Chief of Engineers a copy of the documents in the case, and from Col. Black a statement of the details of the scheme as now worked out. From this information we have prepared the following account.

Report of the Board.

The important sections of the Board's report are as follows:

An examination to ascertain the present cond[ition] and the exact location of all fragments of the wreck [and] character of the bottom and underlying strata [and] of soundings, borings and exploration by div[ers] in progress. This work is being done rapidly [and] oughly.

The knowledge which the Board already p[os]sesses of conditions in Havana harbor enables it to [speak] with confidence that no severe storms, except those [of] the characteristics of hurricanes or tornadoes [may] anticipated. Havana harbor is well sheltered; [that] as in 1906, a hurricane might cause the temp[orary] suspension of any work in progress, but, if the [work] posed by the Board are approved, it is believed [that] so severe a storm would not cause any serious [damage] work already done. Wave action in the vicin[ity of] the wreck is generally slight. Under the worst [conditions] waves more than 2 ft. high are not to be expect[ed]. The tidal range is somewhat less than 1 ft. The [extreme] range is slightly over 2 ft.

The intimate knowledge possessed by members of the Board of the conditions in Havana harbor also enables it to state with confidence its belief that borings subsequent to those already made will indicate no marked departure from the conditions disclosed; there may be some slight variations in the depth of the several strata, but it is believed that there will be no marked difference in the character of the material found.

The Board has examined with care all of the debates in Congress at the time when the appropriations were made for the work in question and finds that there were three important conditions upon which great stress was laid: First, that there should be made a most thorough examination of the wreck of the "Maine" with a view to ascertaining, if possible, the cause of the disaster; second, that all of the remains of the men who went down with this vessel, and which are still therein, should be recovered in order that they may be given honorable burial in Arlington Cemetery; third, that the military mast still attached to the wreck of the "Maine" should be recovered intact and erected as a monument over the graves of these seamen. The plan which the Board proposes is based largely upon the above conditions which it seems to have been the will of Congress to impose.

It is well known that there have been numerous discussions as to the cause of the disaster, which resulted in the destruction and sinking of the battleship "Maine"; from time to time there have been statements made that the United States was unwilling to disclose, or even to discover, just what was the real cause of this disaster. The Board believes such statements to be absolutely unfounded, and, as evidenced in the debates in Congress, that the United States is anxious to do everything in its power to render it possible to make a most thorough examination of this wreck in order that its cause may be ascertained if in any way whatever it is practicable to do so.

There have been a great number of possible methods suggested to the Board, but those which have any merit at all may be divided into two classes: First, methods by means of which the wreck may be raised bodily from the bottom by placing underneath it or attaching to it cables of sufficient strength and in sufficient number, the wreck to be lifted by attaching these cables to caissons which may be sunk by admitting water thereto and, after the cables are attached, pumping out this water and permitting the excess buoyancy of these caissons to lift the wreck to the surface; or by building around the wreck a wharf or a series of caissons* and then lifting the wreck by attaching the cables to mechanical devices to be operated on this wharf or on these caissons; second, placing a cofferdam around the wreck, unwatering it, examining the wreck in situ, and then raising or removing it by one of several practicable methods, either breaking it up and taking it out piecemeal, or, if conditions permit, placing a bulkhead aft of the destroyed portion and then bringing the wreck to the surface by admitting water to the cofferdam. By this last method it may be necessary to cut off the destroyed portion of the vessel and remove this latter part piecemeal.

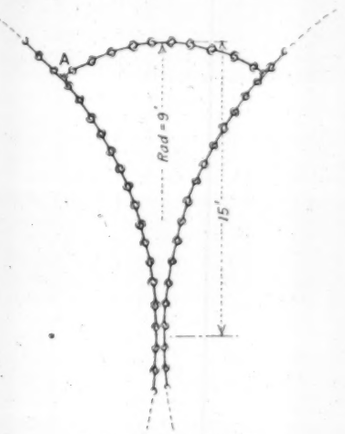
The Board is most decidedly of the opinion that the second of these two methods is to be preferred, and that, to accomplish the wishes expressed in Congress, it is absolutely essential that an opportunity should be given to examine the wreck thoroughly just as it lies and before there has been any change whatever in the relative locations of any of its parts or chance of such change. It is manifest that any plan which proposes to raise this wreck before it has been exposed to view will beyond question necessarily result in the alteration of the relative positions of some of the portions of the wreck or the fragments thereof; even if cables were to be placed under the undamaged part of the vessel only, the great weight of the injured part would cause some deflection of its members and even the slightest disturbance of these pieces of wreckage or the alteration of their location with reference to the other parts of the wreck might render absolutely impossible a decision as to the cause of the destruction of the "Maine."

For the reasons above given, the Board pro[poses]

*See Engineering News, Aug. 4, 1910, p. 126.

a cofferdam around the wreck of the "Maine" sufficiently strong and stable to answer the purpose for which it is intended; to unwater this cofferdam and to clear away around the damaged portion of the vessel in such manner that a thorough investigation, if desired, may be made of every portion of the "Maine" just as it lies and as it has been in any way disturbed. Thereafter, it is proposed to raise or remove the "Maine" by whatever method this examination may show to be the most practicable and most economical.

Attention is respectfully invited to the fact that the Board does not consider that it is charged with any examination of this wreck with a view to a determination of the cause of the disaster, nor is it ordered to express any opinion upon this matter. The Board proposes, however, to lay bare the wreck in order that such examination may be made by any properly constituted authority. The Board has already expressed its opinion that it would be desirable to extend an invitation to the Spanish Government to have such representatives as it may desire present when the wreck is in a condition to be examined and the Board now renews this recommendation. It is also recommended that the Navy Department be requested to designate officers to examine the wreck before its removal, and it is believed that it would be well to extend a similar invitation to the Cuban Government.



Plan of Junction of Cylinders.

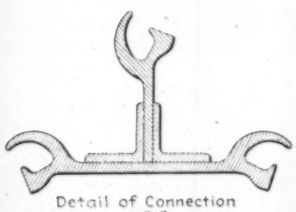

Detail of Connection at "A".

Fig. 2. Detail of the Cofferdam Cylinders.

Respectfully submitted,

W. M. Black,

Colonel, Corps of Engineers, Senior Member of the Board.

Mason M. Patrick,

Lieut.-Colonel, Corps of Engineers.

Sept. 23, 1910.

Method of Raising the Wreck.

As soon as the Board of Engineers received instructions to investigate the case, they started borings in the immediate vicinity of the wreck. The first five of these borings are indicated in plan on Fig. 3 and a section through one of the typical borings is shown in the same figure. This particular boring, No. 2, is very similar to the others that have been and are being made. It will be seen from this that on the bottom of the harbor there is about 15 ft. of a soft clay sand into which the "Maine" has sunk. Below this also is a fairly hard blue clay, which seems to continue until bed rock is reached. Relative observations on the various parts of the "Maine" made to-day and ten years ago show that after its first settlement into the mud in the bottom of the harbor no further settlement took place, so that it seems reasonable that once the soft mud has been cleared away from the wreckage no further settlement need be expected. Test piles were also driven, which, once the soft layer was penetrated, descended in a most uniform manner, showing a hard, dense bottom.

Acting on the information gained from these borings and test piles, the Board recommended that a cofferdam be built around the wreck as indicated in its report above. This cofferdam is shown in Figs. 1 and 2. As it will be seen there, it consists of a series of cylinders 50 ft. in diameter on the sides of the boat, and 40 ft. in diameter at its bow and stern; the clearance at all points is enough to avoid the outlying wreckage. Each cylinder is made up of steel sheet piling, and is connected to the adjacent cylinder only by an arched wall near the outer face and there will be no attempt to make a connection at the points of tangency. The arched wall, as will be seen in detail in Fig. 2, is also made up of sheet piling driven into a special section at the connection to each cylinder.

These cylinders are to be driven to an elevation of —70 ft. which will take them well into the blue clay of the bottom. Once driven, each cylinder is to be filled to the top with earth dredged from a shoal in another part of the harbor. The space between the cylinders and the arched wall is also to be filled in a similar manner. When the interior of the cylinders is filled to the top continuously around the cofferdam, pumping will be started and the whole dam unwatered. An examination of the wreckage will then be made, and if possible or desirable some means will be taken to raise the wreck. If, however, this is not possible, the wreckage will be broken up and disposed of in some other manner.

Each cylinder is to be driven around a template fixed on a pile driven in the center of the cylinder. This template will be first fixed and the steel piles tapped down a slight distance into the mud in the bottom, just sufficient to hold them steady, and when the entire circle is completed the cylinder will be driven as a unit. On account of the difficulty in handling 70-ft. lengths of steel piling, they are to be cut in 30 and 40-ft. lengths, and are to be spliced when driven. All this work is to be carried on under the direction of the Board of Engineers by day labor and with material purchased by the Board. In this way it is hoped to get the work so well along that the "Maine" will be open to inspection before Congress adjourns next March.

Recommendations of the Chief of Engineers.

In submitting the report of the Board to the President, Gen. Bixby made several recommendations. The most important of these are as follows:

No serious consideration has been given by the Chief of Engineers or the Special Board, to such propositions for this wreck removal as provide for giving the removed portions to the proposer for purposes of exhibit as curiosities along the Atlantic coast or otherwise. It is assumed from past discussions in Congress that such use of the wreck would be offensive to the better element of the American public. Under such circumstances, the present plan proposes exposure of the wreck in such way that any portions of value may be disposed of as Congress may later decide, or the entire wreck and wreckage may be given a deep sea burial.

The engineer officer, acting for the Special Board in preliminary work at Havana, has already in his possession, through the courtesy of the Cuban Government, the use of a storage yard, of a good dock front, of steam hoisters, dredges, pile-drivers and pumping apparatus. These are freely loaned by the Cuban Government to the United States, but might not be so readily loaned to outside contractors. With this plant, work can be immediately commenced, and other plant can be added as its necessity becomes evident.

The particular engineering method of work, using a cofferdam of interlocking steel piling as a preliminary to the exposure and subsequent removal of the wreck of the "Maine," as recommended, is the result of a careful study of all the various propositions so far submitted to the War Department for the removal of this wreck. As stated in effect by the Board, it appears especially desirable that, prior to removal, the wreck shall be exposed to view in condition as little changed as possible so that its present actual condition may be easily and fully inspected and thoroughly known; and such condition withdraws from further consideration any method of floating the vessel to the surface by the use of air or other like material pumped or otherwise placed within the wreck, by lifting it with chains or cables either passing beneath the wreck, or attached to its sides. As is well known, this wreck has now been in the water for more than 12 years, its forward portions having been seriously shattered by explosion, and its remaining portions necessarily badly injured by rust; under which circumstances air pressure from within would be liable to tear out its decks without removing the sides and bottom, and chains underneath or on the sides would be liable to tear their way through the weakened metal or at least to alter the present condition of the vessel very decidedly. On the other hand, by surrounding this wreck with a cofferdam which can be pumped out, the abstraction of the water will immediately expose the upper portions of the wreck to view, and the subsequent removal of the mud by shovel or water jet will expose the lower portion without deranging in any way its present condition. It may be assumed that the wreck has already embedded itself so solidly in the mud of Havana harbor that, after the unwatering of the caisson, the wreck will either stand firmly on its own bed or can easily be held there by bracing against the interior walls of the cofferdam. Moreover, the construction and the unwatering of a cofferdam is a piece of engineering work of every day practice, involving no special difficulties and being mainly dependent upon funds and time necessary for ordinary progress of work. The arrangement of the proposed cofferdam, as regards its distance from the side of the wreck, is such as to place it within reasonable reach of the wreck for purposes of side-bracing, and yet far enough from the wreck to allow the cofferdam to inclose all loose wreckage supposed to have been thrown off of the wreck by interior explosion at the time of the sinking of the vessel. The conditions already known, and recently verified, in Havana harbor regarding the extent to which water levels are affected by winds and tides, the depth of water and mud, and the depth and stability of underlying material, make the cofferdam method a comparatively simple process.

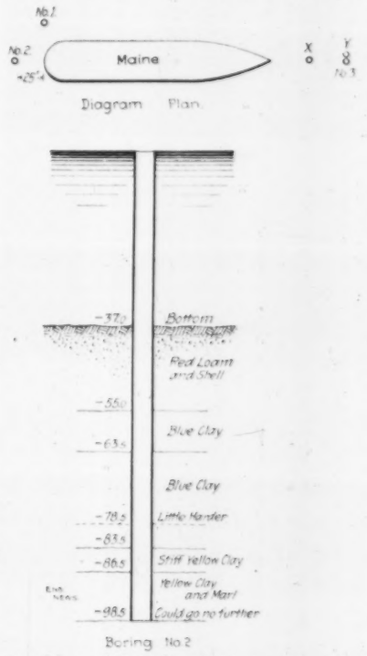


Fig. 3. Plan of First Five Borings and a Typical Boring Section.

Estimates of cost, while already prepared as a basis for comparison of methods and for progress of work and for determination of what can be done within the limits of the present appropriation, are not, as yet, submitted in detail for many reasons; but they show that the $300,000 already appropriated will cover the preliminary boring and test pile-driving now in progress, the preliminary dredging and removal of loose wreckage along a line to be occupied by the cofferdam, the cost of the steel sheet piling delivered at Havana, the driving of the same, the clay and rock filling of the cylinders, lumber for forms and forming, the banking of mud inside the cofferdam where useful, the unwatering of the cofferdam, the bracing of the wreck, all with a liberal margin for contingencies; and it is quite probable that there will still remain a moderate amount of money available for partial removal of the wreckage which may be found within the cofferdam.

On the supposition that, after the wreck is once exposed to view, Congress may prefer that it shall be given a deep sea burial and thereby disposed of beyond resurrection, there will still remain the work of removal of the wreck itself and of the cofferdam, and work of restoration of the adjoining harbor to its condition before the date of the wreck.

The actual removal of the wreck and restoration of the harbor to its original condition may require a further appropriation from Congress of not exceeding $200,000. While this estimate may be considerably reduced at a

later date, it is not considered safe to submit any lesser estimate at the present time; this estimate being such that the total of the work under present and future appropriations will not exceed the rough estimate already given by the last Chief of Engineers while the matter of appropriations was before Congress.

W. H. Bixby,
Chief of Engineers, U. S. Army.

The President's Approval.

In approving the reports of the Board and of the Chief of Engineers, President Taft wrote:

I fully concur in the recommendations of the Board and of the Chief of Engineers and the Acting Secretary of War, and approve not only the plan but also the methods of doing the work by hired labor and purchase of materials in open market in order to secure due speed.

I believe Congress intended that this work should be done as promptly as possible and also under such conditions that information as exact as possible should be secured in respect to the cause of the explosion, and that these considerations should have more weight in determining the plan of procedure than even those of economy. To retain complete control of the work in the hands of the Army Engineers will strengthen public confidence in the results shown.

Since the decision of the engineers as noted above, Havana harbor has gone through one of the worst hurricanes in its recent history (see p. 429 of this issue), but we are authoritatively informed that this will have no effect on the plans. The portion of the harbor where the "Maine" lies is well protected, and observations have shown that even under the most severe storms the waves do not run excessively high. As the only danger there during storms is from wind, the stability of the cofferdam itself would never be threatened by a hurricane and warning is generally given in time for the barges and work boats either to get to a place of safety or to anchor so securely that the wind could not move them.

Annual Convention of the American Street and Interurban Railway and Allied Associations.

The 29th annual convention of the American Street and Interurban Railway Association, and the last one to be held under that name, opened at Atlantic City on Oct. 10. There was an attendance of slightly over 3,000. This association and the five affiliated ones (of the accountants, engineers, claim agents, traffic officers and manufacturers) apparently were never in healthier condition, and it is only an extension of activity to cover the entire field of electric railroading that has led to a change of name to that which these bodies will hereafter bear—"The American Electric Railway Associations."

Of all these several associations only that of the manufacturers of electric railway apparatus and supplies did not have a formidable program of meetings. These men, however, contributed in no small measure to the success of the convention by their attractive exhibits and substantial contributions to the comfort and entertainment of all in attendance. The program of the other associations' meetings showed altogether about 30 committee reports and 25 papers and addresses. Such an extended range of topics has been possible only by the scheme of parallel sessions, as many as four being run simultaneously. This, of course, worked some hardships to men interested for instance in rate problems, shop accounts and prevention of accidents which were discussed at one and the same time. The daily convention issue of the "Electric Railway Journal" was the last resort for those men with varied interests, for on each morning this journal was at hand with the several leading papers, reports and discussions of the previous day.

Only one of the several meeting halls was adequate, the others lacking in light and attractiveness and abounding in noise. The exhibits were as numerous and as attractive as in previous years, though the facilities on the convention pier were evidently not as good. The two most prominent features, perhaps, were manganese-steel special trackwork and pre-payment-car equipment.

The entertainment features were sufficient to keep filled any spare moments the delegates or guests might have had; receptions, card parties, teas, concerts, an indoor baseball game, a grand ball and an amateur vaudeville show all had a place on the program.

The results of the elections of officers of the several associations were as follows:

AMERICAN ASSOCIATION.—President, A. W. Brady (Indiana Union Traction Co., Anderson, Ind.); Vice-Presidents: T. N. McCarter (Public Service Ry., Newark, N. J.), G. H. Harries (Washington Ry. & Electric Co., Washington, D. C.), C. N. Black (United Rys. of San Francisco), W. G. Ross (Montreal St. Ry.).

ENGINEERING ASSOCIATION. — President, W. J. Harvie (Utica & Mohawk Valley Ry.); Vice-Presidents: E. O. Ackerman (Columbus Ry. & Light Co.), J. S. Doyle (Interborough Rapid Transit Co., New York City), Martin Schreiber (Public Service Ry., Newark, N. J.).

TRANSPORTATION AND TRAFFIC ASSOCIATION.—President, H. C. Page (Consolidated St. Ry., Worcester, Mass.); Vice-Presidents: J. N. Shannahan (Washington, Baltimore & Annapolis Ry.), C. E. Learned (Boston El. Ry.), Dana Stevens (Cincinnati Traction Co.).

ACCOUNTANTS' ASSOCIATION.—President, W. H. Forse (Indiana Union Traction Co.); Vice-Presidents: M. R. Boylan (Public Service Co., Newark, N. J.), Wm. Brown (Utah Light & Ry. Co.), H. E. Smith (Montreal St. Ry.).

CLAIM AGENTS' ASSOCIATION.—President, H. V. Drown (Public Service Ry., Newark, N. J.); Vice-Presidents: H. K. Bennett (Fitchburg & Leominister St. Ry., Fitchburg, Mass.), C. A. Avant (Birmingham Ry., Light & Power Co., Birmingham, Ala.), W. S. Heaton (Los Angeles-Pacific Co.).

The American Association.

The meetings of the parent body commonly called "The American Association," were three in number, two of which were "executive," although the program for all meetings and the results of the "executive" deliberations generally were published. The only visible effect was the exclusion of a number of unaffiliated associate members who, though interested in the topics on the program, were forced to get their information second hand.

The annual address of the president, Mr J. F. Shaw (Citizens Electric Ry., Boston) almost came within the description of routine business, such as the reports of the secretary-treasurer, and the various committees. This address was a general summary of the year's activities, closing with a review of the general electric-railway situation. While it was noted that the price of materials had fallen slightly, labor had increased so that the trouble of high general operating expenses had been aggravated. The remedies Mr. Shaw proposed lay in means of increasing revenue and in such publicity as would cause the public to recognize the railways' needs.

Detailed account of the year's work was shown in the various committee reports like those on "Convention Subjects," "Membership," "Compensation for Carrying U. S. Mail," "Brill Prize,"* "Welfare Work," "Interstate Commerce Commission," "Insurance," "Public Relations," "McGraw Dictionary."

A feature of the one public session was an address by Mr. F. R. Ford, of Ford, Bacon & Davis, of New York City, on "The Coney Island Fare Question." It was an exposition of the study of the Coney Island and Brooklyn R. R. at the time of recent hearings, before the Public Service Commission for the First District of New York, on the reasonableness of a 10-cent fare from Manhattan to Coney Island—that is for a 12-mile ride with the traffic very largely confined to only six months of the year, and even then to holidays, Saturdays and Sundays. For a time dividends had been paid up to 16%, but these were followed by calls on the stockholders for funds to rehabilitate the property. No "water" was found in the stock but it was found that even the contested 10-cent fare did [illegible] a reasonable income above expenses a[illegible] cent fare would have given heavy lo[illegible] In the winter time the gross earnings did [illegible] over platform expenses. The most important [illegible] of Mr. Ford's paper was the application [illegible] this case, of a method of studying valuati[illegible] from five viewpoints: (1) capitalized earning[illegible] ver, (2) market value of securities, (3) appro[illegible] ap-italization, (4) cash investment, (5) r[illegible] duc-tion value. A feature of the last study [illegible] s an unusually thorough investigation of the [illegible] t of developing such an electric railway from [illegible] mere idea to the going concern (of about $8[illegible],000 capitalization). The actual cost of de[illegible] ping the ideas, securing the charter and fra[illegible] ises, etc., was placed at $421,000; $217,000 was [illegible] eded in securing the property owners' consents [illegible] 195,-000 went to cover expenses and time [illegible] per-manent organization during construction. The total was $895,000 and the reproduction [illegible] alue including such factors was $9,300,000.

The discussion on Mr. Ford's address, [illegible] ewed as a whole, reflected a differing sentiment among electric-railway officials. For instance, Mr. T. N. McCarter (Public Service Ry., of N[illegible] ark, N. J.) made a vehement demand that the rail-way men be given such latitude in the matter of rates that they could earn more than 6 or 7%. He felt that recent court decisions, like the Knoxville water case, took away all hope of re-course to the courts to prevent confiscation of property and that legislation must be sought to remedy the trouble. On the other hand, Mr. J. I. Beggs, of Milwaukee, whose company has been under somewhat corrective study by the Wisconsin Railroad Commission announced his faith in the aims and efforts of an able commission and his belief in the utility of a just engineering valuation of the physical property for roads where justifiable cash expenditure and capitalization were not near neighbors—a condition largely existing in the middle west. Some speakers predicted a reaction against strict regulation and attendant valuations and others saw only an extension of present tendencies.

At the second (executive) session, in addition to the progress report of the committees on Public Relations (describing the Association files of state and public-service statutes) and Interstate Commission Affairs (reviewing recent federal legislation), there were two addresses.

The first was "The Public Side of Street Railroading," by Mr. Patrick Calhoun (United Rys. of San Francisco). It was a review of causes for an unfavorable public attitude toward street-railway corporations—such as just and unjust public demands, lack of municipal cooperation, political blackmail, etc. The remedies advised were education, full publicity, freedom from political alliances, stern integrity in public and private operations of the corporations, establishment of public-service commissions, and the rule of law at times of strikes.

The second address of this session, "The Philadelphia Situation," by Mr. C. O. Kruger (Philadelphia Rapid Transit Co.), was not made public.

At the third and last session of the American Association there was one report, that of the Committee on Education (relating their efforts to establish a correspondence course among the employees of member companies, but not reporting definite results), and there were three addresses.

"Street-Railway Franchises," by Mr. Chas. V. Weston (Pres. South Side El. Ry., Chicago), was the first. He urged that the best type of franchise was a monopoly grant, fixing the rate of dividend according to the risk in the venture and limiting the capitalization to the legitimate cost of such a project. He would have extensions into sparsely settled territory in part supported by the local interests benefited, and there would be provisions for protecting the investment at the termination of a franchise, with publicity of the company's accounts and affairs at all times. This desirable franchise, Mr. Weston would make possible for future railway development by a campaign of education.

The second address, "What Interurban Rail-

*Prize for the best undergraduate thesis on an electric-railway subject; see Engineering News, Oct. 21 (p. 449) and Dec. 30, 1909 (p. 719).

ways Do for the Public," by J. A. M'Gowan (Chas., Indianapolis & Easton Traction Co.), was a summary of growth in Indiana. He summed up this by the statement that the 11 miles of 1898 had grown to 1,800 and the passengers carried had increased to 20,000,000 per annum. Gross earnings had risen to $10,000,000 and farm property, largely through interurban-railway development, had appreciated from $540,000,000 in 1900 to $662,200,000 in 1909.

The final address was on "Taxes and Licenses," by Mr. G. E. Tripp (Stone & Webster, Boston). It was an argument supporting the proposition that the street-railway industry probably pays a larger percentage of its gross earnings to support public expenditures than is paid by any private corporation or individual, when it should pay less on account of its public services. The ideal tax Mr. Tripp held to be in the form of a single percentage of gross earnings from which the amounts paid on real and personal property should be deducted.

Engineering Association.

The acting president's address of Mr. W. J. Harvie (Utica & Mohawk Valley Ry.) was a report on the year's activities. After speedily clearing away such routine business as demanded attention at each session, reports of technical committees were discussed.

The first of these was on "Way Matters." This report was in fact a collection of five reports on (1) Specifications for Open-Hearth Girder and High T-rails, (2) Standardization of Girder Rails, (3) Track Gage on Curves, (4) Rail Joints, (5) Economical Maintenance.

Concerning the first of these five topics the committee said:

> Owing to the increasing use of open-hearth steel for high T and girder rails it has been considered that the adoption of a uniform specification for the manufacture of such rails would be of benefit. We recognize the necessity for a very hard metal, that will effectually resist the abrasion due to street-railway traffic, and for the high-carbon content required in such a steel. While the brittleness of a high-carbon steel is objectionable, it is not so serious as in steam-railroad work. It was necessary to decide what hardness was desirable and what brittleness could be tolerated.

A set of specifications, largely drafted by Mr. J. M. Larned (Pittsburg Rys. Co.) was recommended to the standards committee of the Association for adoption as standard practice. The most interesting points were in the chemical composition and heat treatment, which were regulated as follows:

> The steel shall conform to the following in chemical composition:
>
> | | Per cent. limits. | Desired per cent. |
> |---|---|---|
> | Carbon | 0.60—0.75 | 0.68 |
> | Manganese | 0.60—0.90 | 0.80 |
> | Silicon (not to exceed) | 0.20 | .... |
> | Phosphorus (not to exceed) | 0.04 | .... |
>
> An increase of 0.035% carbon above the upper limit will be permitted for each decrease of 0.01% of phosphorus below 0.04%. The number of passes and speed shall be regulated so that on leaving the rolls at the final pass the temperature of the head shall not exceed: (1) 1,900° F. for rails weighing 100 lbs. and upward, (2) 1,700° for rails weighing less than 100 lbs. The bars shall not be held for reducing temperature nor shall any artificial means of cooling be used between leading and finishing passes nor after finishing pass.

Two standard designs of girder rails, 7-in., 106-lb., and 9-in., 120-lb. sections, were recommended to become standards. Two similar forms of guard rails to match were also recommended. The relation of these to present "approved-practice" rails which are somewhat heavier was not explained. Rules for gage and flangeways of track on curves were also recommended to the Standards Committee for promulgation. What has been previously recommended for standard T-rail street construction was again urged.

An exposition of the past troubles with rail joints and of the essentials of satisfactory joints, together with a description of the principal types now in vogue formed a part of this Way Committees report.

The subject of economical maintenance was covered in an appendix prepared by Mr. Martin Schreiber (Public Service Ry., Newark, N. J.). His discussion showed the economies in (1) proper organization of the way department and ample shop, storing and shipping facilities, (2) suitable unloading and loading machinery, adequate work cars, etc., (3) use of standard pieces, (4) grinding true all rail joints, (5) grinding out corrugations early, (6) purchase of supplies under specification and inspection, (7) treated ties and timber, (8) proper accounting system and complete engineering records.

The report of the Committee on Power Generation was a brief outline of progress in (1) use of forced draft, (2) flue-gas analysis, (3) low-pressure steam turbines, (4) steam meters, (5) caring for peak loads. The several topics were presented by single members of the committee. It was stated that, with low-grade fuel, forced draft made possible an increase of efficiency, though at very high combustion rates the efficiency fell off. High air pressures were beneficial up to the limits where coal was blown over the bridge wall, where excessively hot spots in the fire developed, and where the increasing cost of air supply overcame the gain. Problems still remain to be worked out in the design of ducts and ash pits to minimize the pressure loss, in the design of furnaces to permit higher air pressures and of boilers for higher gas velocities, and finally in the better control of boiler capacity and efficiency.

Valve of flue-gas analysis, it was held, seemed to have been over-rated; since the effect of velocity of gas through the boiler tubes had became better known, the importance of CO_2 percentages was regarded as secondary.

Low-pressure steam turbines were recommended where good engines were installed and where load factor and coal cost were high. The cost of entire additional equipment complete would not exceed $25 per KW. capacity.

After describing the several types of steam-flow meters available, it was stated that Pitot and Venturi meters were most simple, durable and easy to install and to operate. The Venturi tube, it was expected, would eventually offer the most reliable and accurate type.

The problem of economically carrying peak load was held to be best solved at present by the use of steam turbines, by decreasing the ratio of grate area to heating surface, with forced draft.

The report of the committee on heavy electric traction presented only two topics; (1) specifications for heat-treated steel axles, and (2) standard location for third (conductor) rails. The first topic was a continuation of last year's work in developing a material, for heavy steel axles subjected to the hardest service, which would approach the qualities of alloy steels without the extreme expense of such. A set of standard specifications was submitted for consideration, the most important ideas disclosed being seen in the following paragraphs.

> Each axle is to be allowed to cool after forging, is then to be reheated to proper temperature, quenched in some medium, allowed to cool and then reheated to the proper temperature for annealing.
>
> Drillings for analysis and U. S. Navy Standard tension test piece (specimen 2-in. × 0.505-in.) will be taken from the crop end parallel with the axis on any radius, 50% of the distance from the center to the circumference.
>
> Test pieces, cut from one out of every ten axles, must show, when tested by the company's inspector, the following characteristics: (1) Ultimate strength not less than 85,000 lbs. per sq. in.; (2) elastic limit not less than 50,000 lbs. per sq. in.; (3) elongation in 2 ins. not less than 22%; (4) contraction of area not less than 45%. The elastic limit is to be determined by extensometer, the increments of load between readings above 40,000 lbs. to be 1,000 lbs.

The proposed standard specifications were left, however, to the joint consideration of this committee and one from the American Society for Testing Materials.

In considering a standard location of third-rail conductors, the committee had in mind the standard adopted by the American Railway Association in 1908. It was assumed that third-rail conductors would be used for strictly heavy traction operations and conditions obtained on American steam roads alone were considered. The committee found that the data and conditions, on which the American Railway Association acted, held still and recommended the same standards, only one member dissenting. The location recommended was as follows:

> The gage line of the third rail is to be located not less than 26 ins. and not more than 27 ins. from the gage line of the track and the contact surface of the third rail is not to be less than $2\frac{3}{8}$ ins. or more than $3\frac{1}{2}$ ins. above the plane of the top of the track rail. (Lines of clearance for both rolling equipment and maintenance-of-way structures as shown in sketches; and left open pending action by the American Railway Engineering and Maintenance of Way Association.)

The report of the Committee on Power Distribution had to do in part with specifications for high-tension, three-conductor, paper-insulated cables. The outlined requirements of conductivity, insulation, sheath, testing and installing were discussed at length and the report was "accepted," which means that the proceedings may be used by future committees for formulating standards to be later proposed.

A joint report of committees from the American Railway Engineering and Maintenance of Way Association and the National Electric Light Association was presented with the Power Distribution Committee's criticisms. These were numerous and important, so that the whole matter was left in the hands of the Executive Committee with the recommendation that cooperation was desirable, but that many of the specific requirements were objectionable in needing definition and too greatly favoring the steam railways.

The Committee on Equipment took up several subjects in its report, but presented extended remarks, which aroused discussion, on only two topics; (1) "Reducing Car Weights in New Construction," and (2) "Rolled Steel Wheels of Light Design for One Wear." Both of these parts of the report were largely the work of Mr. M. V. Ayres (Boston & Worcester St. Ry. Co.). The first was a description of the many types of platform framing, bolsters, etc., devised to secure stiffness as well as strength, together with the opinions of a few car builders on the relative value of these constructions, on arched and monitor roofs, etc. While there was no complete agreement on all points, it was evident that car body, trucks, and electrical equipment could be considerably reduced if necessary. In the discussion, car manufacturers called attention to the need of a heavier general construction for cars running on poorly maintained trackwork than on the smoothest roadbeds. The practice was to build cars for only average conditions, which might be lightened for some particular locations.

The second topic, "Rolled Steel Wheels of Light Design for One Wear," was a theoretical statement of the over-all economy of such wheels (which have not been made). In brief, the removal of 100 lbs. from the rim, it was expected, would reduce the power consumption enough to over compensate for greater first cost per unit mileage. The computed saving was 88 cts. per 10,000 car miles with a wheel costing $2 less. This comparison was objected to by the wheel makers on the ground that it would actually cost more to produce the one-wear wheel than the present type. They signified their readiness to make such a wheel but at problematical cost.

The Committee on Buildings and Structures in a long paper outlined broadly the considerations of general location, track layout, and building construction which are involved in the design of most suitable urban and interurban passenger terminals. Details were furnished in an Appendix by Mr. Martin Schreiber (Public Service Ry., Newark, N. J.).

The Committee on Standards approved a standard section for No. 0000 grooved trolley wire and a standard copper-wire table, and kept in the "recommended practice" class, specifications for steel axles, for ordinary cables and for proposed rail sections.

Traffic, Accounting and Claim Agents Associations.

The scope of the meetings of these several associations is shown best by the following summary of their programs.

(1) Traffic Association: Reports of Committees on Passenger Traffic, on Interurban Rules, on City Rules, on Express and Freight Traffic, on Transfers and Transfer Information, on Training of Transportation Employees, on Construction of Schedules and Time Tables; "Creation of Pass-

enger Traffic," by J. F. Keys (Detroit United Rys.), "Use of Metal Tickets," by G. L. Radcliffe (Cleveland Ry. Co.), "Transfer Laws and Suggested Changes," by L. S. Hoffman (Public Service Ry., Newark, N. J.).

(2) Accountants' Association: Reports of Committees on Interline Accounting, on Shop Accounting (at a joint session with the Engineering Association), on Standard Classification of Accounts; "The Census and Electric Railway Statistics," by W. M. Steuart (U. S. Census Bureau, Washington, D. C.), "Freight and Express Accounting," by T. L. Hixson (Terra Haute, Indianapolis & Eastern Traction Co.), "Accounting Features of the Cleveland Street Railway Franchise," by H. J. Davies (Cleveland Ry. Co.), "Payrolls and Invoices," by N. E. Stubbs (United Rys. & Electric Co. of Baltimore), "Collection and Auditing of Receipts of Prepayment Cars," by M. R. Boylan (Public Service Ry., of Newark, N. J.), "Detail Records, Their Use and Value," by J. H. Neal (Boston El. Ry.).

(3) Claim Agents: "Matters Interesting Claim Departments as Subjects of Legislation and How Claim Agents Can Best Exert Proper Influence to Obtain Legislation," by J. R. Pratt (United Ry. & Electric Co. of Baltimore), "How Can Claim Departments Best Obtain Complete and Truthful Reports from a Car Crew?" by J. J. Reynolds (Boston El. Ry.), "Mechanical Devices for Preventing Accidents," by H. V. Drown (Public Service Ry., Newark, N. J.), "How Claim and Operating Departments Should Cooperate," by H. C. Page (Worcester Consolidated Ry.).

Comparatively few of these reports and addresses were of engineering interest. Three from the Traffic Association program, however, have seemed useful to review.

The report of the Committee on Transfers and Transfer Information, after a canvas of the railway companies of the country, found that most companies suffered financially, more or less, from misuse of transfers and that no general scheme had ever been put into effect to protect the roads. However, it was found that several effective methods were in vogue. With the data secured, the committee formulated several general conclusions:

(A) That a standard form of calendar transfer be adopted. (B) That the transfer tickets intended for a. m. and p. m. use be distinctive. (C) That date of transfers be canceled by clerk at car barn before they are placed in hands of conductors; or, in case of larger companies, date to be printed if desired. (D) That use of transfers be limited, so far as possible, to travel in one general direction, which might be controlled by creation of transfer districts, showing point at which slip is issued as well as direction in which it is intended to be used. (E) That conductors be required to make returns of transfers collected every half trip where feasible, otherwise at the end of each round trip.

In the paper "Transfer Lines and Suggested Changes," Mr. Hoffman urged that effort be made to secure the passage of laws against abuse of transfers nearly as stringent as in force in New York, where a fine of $500 or imprisonment for a year or both can be imposed. His proposed statute cut down the penalty to $100 or six months in prison.

The Report of the Committee on Passenger Traffic showed the trend of replies to the question "What passenger rates should interurban roads charge" It was found that most of the present roads charged 2 cts. per passenger mile, a figure which was recommended as a proper charge, except where construction and operation charges were unusually heavy.

The most interesting item on the Accountants' Association program, perhaps, was the report of the joint committee on shop accounting. This presented a scheme for the subdivision of primary accounts wherever information was found desirable about the cost of operation of the way and structure, of the equipment, and the power-plant departments.

The paper "Detail Records; Their Use and Value," was along similar lines, as it held (1) that on some original record the smallest transactions should be recorded, (2) that for intelligent management of a property the study of almost every item was needed by some one, (3) that this detailed data could be used to as good advantage outside the main office as within (so as to eliminate certain minor troubles and to lessen repair costs), (4) that self-indexing filing made a mass of such information instantly available.

One of the most notable items in the Claim Agents' Association program was the discussion of the work of the Hooper-Holmes Bureau, whose services this association has secured for preventing fraudulent claims. It was stated that, in 5½ months, notices of 2,874 claims had been filed by 34 out of 350 member companies, although 2,467 of these reports had been filed by three large companies. In 175 cases previous or simultaneous claim records had been found. The bureau also works with accident insurance companies so that records of claims for injuries received on electric railways are opened to the railway claim agents and, being duly sworn to and carefully reported, form an accurate basis for an equitable settlement.

Notes on the National Irrigation Congress of 1910.

By SAMUEL H. LEA.* M. Am. Soc. C. E.

The Eighteenth National Irrigation Congress was held in Pueblo, Colo., Sept. 26-30, 1910. The formal opening of the Congress was preceded by an industrial parade which started at 10 a. m., Monday, September 26. This parade was a creditable affair for Pueblo and the local and visiting bodies participating in it. There were Indians in their feathers and war paint, the pioneer in the old-time stage coaches, prairie schooners, and an early-day pack train, followed by floats showing modern agricultural and industrial development. With the spectacular features of the opening day over, delegates turned to the more serious business confronting the Congress during its five days' session. The meetings were held in the Mineral Palace, a white building of imposing architecture, used as a show place for Colorado minerals, and containing a large assembly hall. The attendance, while not as large as at some former sessions, was cosmopolitan in character, the delegates coming from all portions of the United States and from foreign nations. In all, 33 states were represented, besides the two territories of Arizona and New Mexico, and the District of Columbia. The total attendance was about 1,100 delegates. The following foreign countries were represented by special delegations comprising one or more members: Austria, Australia, Hungary, British Columbia, Canada, Chile, Cuba, Germany, India, Mexico and Russia. The foreign representatives were given a special session, at which papers were read by delegates from various parts of the world.

Proceedings.

The proceedings of the Congress, comprising the reading of papers, delivery of addresses and discussion of same by the delegates, were of great interest. The speakers were selected from among those best posted in the various topics selected for consideration, and, coming as they did from all over the world, these speakers represented many phases of thought and practice. One was forcibly impressed with the importance of irrigation to the world's agriculture, when viewing this vast assemblage, which really assumed an international nature, broader in scope than its title.

The first day was given over to addresses of welcome, responses, etc. In the evening an informal reception was given to delegtaes and visitors by the local board of control. The second day, Tuesday, was devoted to Irrigation by Private Enterprise. At the morning session, Mr. Frank C. Goudy, former Governer of Colorado, spoke on the "Benefits and Dangers of Private Irrigation." Mr. Norman E. Webster, Jr., of New York, spoke on "Irrigation Accounting" [see Eng. News, Oct. 6, 1910]. W. C. DeCelle, of Illinois, read a paper on the "Status of Irrigation Bonds as Investments," and Mr. H. L. Moody, of Washington, spoke on "Pumping for Irrigation." Mr. Geo. E. Barstow, of Texas, read a paper on "Private Irrigation."

In the afternoon a paper which had been prepared by Mr. F. H. Newell, Director of the U. S. Reclamation Service, and which was entitled, "Progress of National Works," was read to the Congress. He showed that the first estimate of cost and benefits were far too small; that the Federal Government's investment in irrigation amounts to nearly $60,000,000; that the western country is developing by leaps and bounds through the settlement upon this land of thousands of families from the east.

A review of information compiled by the census was presented by Mr. R. P. Teele, in charge of irrigation division of the Census Bureau. Mr. B. J. Viljoen of New Mexico, from the farmer's standpoint, declared that from 10 to 20 acres of irrigated land was enough for the individual farmer. Mr. Samuel H. Lea, State Engineer of South Dakota, read a paper on "The Function of the State Engineer." Mr. W. E. Smythe, of San Diego, Cal., known as the father of the irrigation congress, made a plea for intensive and scientific farming in his talk on "The New Gospel —A Little Land and a Little Living."

At the Wednesday morning session a paper by Judge F. H. Short, of California, on "Control of States over Water Resources," in which he advocated states rights, precipitated discussion between factions representing State and Federal control. Delegate Cuttle, of California, pleaded for continuance of Federal control, at least until such time as present problems were solved. Former Governor Alva Adams, of Colorado, lamented the fact that because California could not trust her legislators, other states were to be robbed of their birthright and forced to submit to Federal influence, and Delegate Finkel of Los Angeles, stated that Mr. Cuttle's views were not those of a majority of California, which latter statement was disputed by Mr. Smythe, another California delegate.

The paper by W. K. Kavanaugh on the "Interdependence of Irrigation and Navigation" emphasized the necessity of the utilization of waters for both irrigation and navigation; the necessity for protection of headwaters of all streams and control of the floods. The speaker further stated that the paramount function of water is the preservation and conservation of life during the course of its flow and as this accorded with the theories of Colorado and mountain states which desire the utilization of the waters near their source, this section of the address was loudly applauded.

Judge J. H. Kibbey, of Arizona, read a paper on "Appropriation of Water"; this was an able exposition of the law as applied to water appropriation. Judge G. H. Hutton, of Los Angeles, read a paper on the "Underground Waters of California." He said that water litigation in the valleys of Southern California is waning and the supply of water is the reason. Owing to conditions applying to California, he stated that the tendency of the decisions of the courts of his state were growing away from the common-law tendency of swampy England and of the rain-soaked eastern states and were looking to the civil-law countries, India, Spain and others, where problems of irrigation have for a long time presented themselves. He cited the case of Katz vs. Walkenshaw as embodying the modern theory of law as applicable to irrigation and water conservation in his state. He stated that under the decision in the famous California case of Lux vs. Haggin, riparian rights and rights of appropriation could exist side by side. He called upon lawyers and engineers to forsake the ancient doctrine of the common law and take up with the ancient civil law for the solution of irrigation problems. Mr. Albert F. Potter, of the U. S. Forest Service, spoke on "The Segregation of Agricultural Lands in Forest Reserves."

Wednesday afternoon Dr. W. J. McGee of the U. S. Department of Agriculture spoke on "The Agricultural Duty of Water." Papers were read on "Irrigation and the Sugar Beet Industry" and also on "Instruction in Irrigation," by Aaron Dove of Denver, and Prof. E. B. House of the Colorado Agricultural College, respectively.

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Thursday morning was the Foreign Representatives' Session. Dr. Elwood Mead, of Australia, who was formerly State Engineer of Wyoming, spoke on water appropriations in Australia. In that country the state gives no perpetual water rights, limiting a permit to 15 years. The effective public control of water-supplies has been simplified by retaining in public ownership not only the water itself but the land through which streams flow, including a strip of land on each bank, from one to three chains wide. The state is, therefore, the sole riparian proprietor. Papers were read by Dr. N. Kaumanns, Special Commissioner from Germany, and by E. S. Kornilakeff, of Russia. The former on "The Water Needs of Plants and the Needs of Securing It," the latter on "Irrigation and Its Problems in Russia."

Thursday afternoon was set aside for a consideration of General Policies, and much interest was taken in this session, since it was understood that Mr. Gifford Pinchot was going to speak then. His address was on "The Actual Battle," and he spoke strongly in favor of Federal control of interstate streams. The largest crowd of the Congress, with the exception of the audience which heard Mr. W. J. Bryan, was present. Mr. Pinchot advocated complete harmony and conciliation, as between State and National control. However, upon the subject of state control of interstate streams, he was uncompromising. He advocated absolute Federal authority over such streams, to the end that they do not fall under the domination of great corporations. Mr. Finkel, of California, followed in a speech for the other side. He believed that states have a right to regulate the corporations within their boundaries and to collect the revenue accruing from such corporations.

After Mr. Pinchot finished speaking he was recalled and was given an elaborately jeweled and tagged "Big Stick" to carry to Roosevelt. Mr. Pinchot accepted the Big Stick in trust, and replied in an appropriate speech.

There was a night session of the Congress, at which papers were read by Prof. Samuel Fortier on "The Agricultural Side of Irrigation"; by F. M. Webster on "The Alfalfa or Lucern Weevil"; and by Prof. W. B. Gregory on "Irrigation of Rice in the United States."

The last day was in some respects the most interesting one of the entire Congress. The event of the early part of the session was the address of Francis J. Heney, the noted California prosecutor. His subject was "Safeguarding the People's Interests," and he took advanced ground in favor of Federal control, advocating the vesting in the people of all that remains of the four great sources of energy—coal, oil, natural gas and water power; and the retention of this control in the Government, development being had by a leasing system. This view was combated by former Governor Alva Adams of Colorado, in a fiery speech, and it looked for a while as if a spirited fight would ensue. However, this controversy was ended and the Congress passed to the consideration of further business.

A feature of the Congress was the controversy between Colorado on one side and Texas and New Mexico on the other, relative to the disposition of the water of the Rio Grande River. Residents of the two lower states and also of Old Mexico along the Rio Grande Valley were prior appropriators of water from the river, irrigating nearly 100,000 acres. In recent years residents in the San Luis Valley in Colorado, near the headwaters of the stream, have made so many appropriations of water that the lower users have been practically deprived of water and thousands of acres have been abandoned for agriculture.

The U. S. Reclamation Service has undertaken the construction of a large dam at Engle, New Mexico, to impound several million cubic feet of water, for the purpose of storing flood waters sufficient to irrigate the lands that have been deprived of water. Further appropriation of water in the San Luis Valley is forbidden on Government land, by the Interior Department. This action was bitterly resented by citizens of Colorado, while the prior users were favorable to it. The matter resolved itself into a question of Federal Control of Interstate Streams vs. State Control of Streams in its borders.

The Congress adopted resolutions favoring Federal control of interstate streams, endorsing the U. S. Reclamation Service, the U. S. Geological Survey and the U. S. Department of Agriculture. B. A. Fowler of Arizona was elected as president to succeed himself, and Chicago was designated as the meeting place in 1911.

Irrigation Exhibition.

The Irrigation Exposition, which was held in conjunction with the Congress, under the direction of Mr. L. M. Markham, occupied three blocks of land near the Mineral Palace, where the Congress was held. The exposition comprised exhibits of agricultural machinery, irrigation methods and products. There were reservoirs, open ditches, pumping plants, subirrigation demonstrations, weirs, systems of measurements, patent flumes, etc.

Convention of the American Electrochemical Association.

The 18th general meeting was held at Chicago on Oct. 13 to 15, two sessions being at the Congress Hotel and one at the University of Chicago. Meetings were held in the morning only, the afternoons being devoted to various excursions.

Three papers related to the subject of electric furnaces. In a paper describing a proposed "Method for Determining Thermal Conductivities," Mr. Carl Hering remarked that there is need for more accurate determination of the thermal constants upon which the design must be based. This is of greater importance with electric furnaces than with coal or gas furnaces, owing to the greater cost of the heat. It has been shown already how the losses in the electrodes (which are generally good thermal conductors) can be reduced to a minimum, and the constants for calculating the best proportions and the losses have been determined. There still remains to be determined accurately the thermal constants for such refractory insulating materials as are used for the furnace walls. The method suggested in the paper has not been tried and was offered only as a suggestion.

A paper on "Reduction of Tin Dross in an Electric Furnace," by Mr. R. S. Wile, described a plant consisting of two furnaces connected in series. They are of the shaft type, 20 ins. diameter and 80 ins. high, and demand about 44 KW. in operation. The furnaces are run continually until they require to be relined, which is about every three or four months. The third paper was by Mr. Marcus Ruthenberg on "The Electric Furnace and Its Application."

Two papers dealt with the electrolytic preparation of calcium. The paper by Prof. A. R. Johnson reviewed the result of experimental work carried on at the laboratories of the University of Wisconsin in 1905-1906, but which have not been made public before this time. The paper by F. C. Frary, H. R. Bicknell and C. A. Tronson supplemented a paper presented at the 1909 meeting, and related especially to the current efficiency of the various processes.

A paper by Mr. F. S. MacGregor on "The Application of Electrostatic Separation to Ore Dressing," related particularly to the Huff electrostatic separator. This is in use at the plants, in Wisconsin, Utah and Nevada. At the Wisconsin plant, the apparatus is used to remove (without roasting) the iron pyrite from the zinc blende, thus converting the low-grade ores into high-grade smelting ores. The principle consists in utilizing the differences in the electrical conductivity of various minerals by giving the particles of ore an electrostatic change. The blende is sold to the smelters. The iron pyrite (formerly valueless) is sold for its sulphur content, and a zinc product is sold for spelter. The Utah plant removes the objectionable zinc from lead-pyrite concentrate. The Nevada plant works on crude silver ores which do not go through any concentrating machinery before the electrostatic treatment.

Three papers were presented relating to electric storage batteries. That by Mr. Pedro G. Salom described the evolution of the lead storage battery, and one by Mr. W. S. Block described a new secondary cell. The third, by Prof. O. W. Brown and W. G. Bowers dealt with the self discharge of Plante and Faure storage batteries.

The World's Production and Consumption of Coal.

PRODUCTION.—In the London "Iron and Coal Trades Review," Sept. 2, are presented the 15th annual returns of the British Board of Trade on the production and consumption of coal in the United Kingdom and principal foreign coal countries. Definite complete figures are shown only to 1908, some of those for 1909 being "provisional." The production and values in the five principal coal countries is as follows for four years:

Years.	United Kingdom.	Germany.	France.	Belgium.	United States.
	Thousands of Long Tons				
1906	251,068	134,914	32,920	23,191	369,783
1907	267,831	140,885	35,411	23,324	428,896
1908	261,529	145,298	36,044	23,179	371,288
1909	263,774	146,507	36,654*	23,182*	390,336*
	Ton Values				
1906	$1.82	$2.22	$2.80	$3.05	$1.44
1907	$2.25	$2.42	$3.06	$3.42	$1.48
1908	$2.22	$2.37	$3.23	$3.28	$1.49

*Provisional figures.

Of all other countries reported, only Russia had an annual production exceeding 20,000,000 tons. The total known production of the world in 1908 was about 950,000,000 tons, exclusive of lignite. Per capita production in the United Kingdom surpasses that in the United States, being 6 tons as compared with 4.5. In Belgium the figure is 3.2 tons and for Germany 2.3; in France it is less than one ton. These figures are not for coal of the same quality in different years or countries, but are affected, for instance, by the variations in proportions of anthracite and bituminous in the output. The figures for the United Kingdom are composed in part of the following:

Years.	British India.	Commonwealth of Australia.	Dominion of New Zealand.	Dominion of Canada.	South Africa (Self-governing colonies).
1906	9,783	8,596	1,730	8,717	4,185
1907	11,147	9,681	1,831	9,385	4,679
1908	12,770	10,194	1,861	9,720	4,938
1906	$0.97	$1.56	$2.64	$2.33	$1.80
1907	$1.16	$1.70	$2.64	$2.67	$1.84
1908	$1.31	$1.84	$2.59	$2.16	$1.79

The number of persons employed in coal mining in 1908 was, in the five principal countries, as follows:

	Number employed.	Output per person employed, tons.
United Kingdom	996,300	271
United States	690,400	591
Germany	591,000	246
France	191,000	189
Belgium	145,300	160

CONSUMPTION.—From the table below it will be seen that the consumption of coal in the United States is over twice as great as in any other country and nearly equal to the total of that in the other principal coal countries, United Kingdom, Germany, France and Belgium.

THE WORLD'S COAL CONSUMPTION.

	1907	1908	1909
	Long tons		
United States	417,867,000	360,935,000	379,050,000*
United Kingdom	182,674,000	176,228,000	177,745,000
Germany	128,411,000	129,845,000	129,738,000
France	52,710,000	52,995,000	54,327,000*
Russia	29,686,000	28,808,000*	.....
Austria-Hungary	24,211,000	25,028,000	.....
Belgium	22,805,000	22,515,000	22,445,000*

*Provisional.

The tons per capita consumption for 1908 is arranged thus (the starred figures being "provisional").

United Kingdom.	United States.	Belgium.	Germany.	France.	Austria-Hungary.	Russia.
3.96	4.14	3.11	2.05	1.35	0.51	0.19*

It should be noted that in France and Germany the small per capita figures are partly explained by the use of other fuels like wood, peat, lignite and denatured alcohol. The tons per capita figures for the United Kingdom are in part made up of the following for colonies over the seas:

Commonwealth of Australia.	Dominion of New Zealand.	Dominion of Canada.	South Africa (self-governing Colonies).
1.43	2.13	2.46	0.74

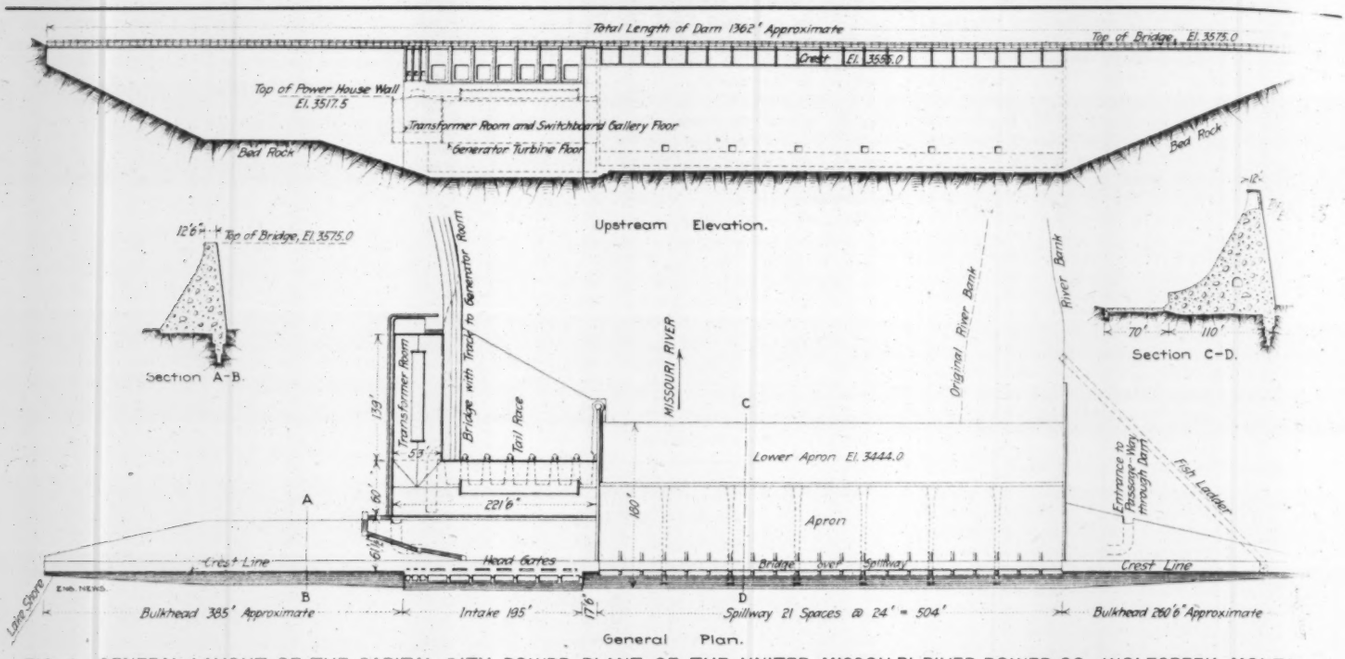


FIG. 1. GENERAL LAYOUT OF THE CAPITAL CITY POWER PLANT OF THE UNITED MISSOURI RIVER POWER CO., WOLFCREEK, MONTANA.

The Capital City Power Plant of the United Missouri River Power Co.

In the past we have had occasion* to describe in some detail the two plants on the Missouri River where the United Missouri River Power Co. generates electric power for distribution to Helena, Butte, Anaconda and other locations in the western part of Montana. As an addition to these two hydro-electric plants and to a steam-turbine plant at Butte, the company is now engaged in the construction of a new plant further up the river, which will add over 60,000 HP. to the total capacity of the company's various other plants. We have received from Mr. M. H. Gerry, Jr., the Chief Engineer of the company, the following description of the latest project prepared by the engineers of the company.

The dam and hydro-electric plant now under construction on the Missouri River by the Capital City Improvement Co., will form a part of the system of the United Missouri River Power Co. This company has already two plants on the Missouri River; one at Hauserlake,† of 25,000,-HP. capacity, and one at Canyon Ferry, of 12,-000-HP. capacity. These powers are developed by means of dams which produce lakes of large area and thus provide storage reservoirs of great value in equalizing the flow of the river. The total available water storage in the three lakes, without appreciably affecting the heads of the plants, will be not less than 150,000-acre-ft., or an amount sufficient to double the flow of the river during the low-water season.

The present plants are used exclusively for the generation of electrical power for transmission purposes, and the new plant of the Capital City Improvement Co. will be used for the same purpose and will be connected to the general system. The electrical power is transmitted as three-phase alternating-current, at 70,000 volts, to the cities of Helena, Butte and Anaconda and to numerous towns and mining camps in the same territory. The Canyon Ferry plant went into service in 1898, and the Hauserlake plant in 1907.

The development under way is variously known as Plant No. 3, Wolf Creek Plant, Holter Plant and the Capital City Plant; in the following it will be designated as the Capital City Plant. It is located about 30 miles north of the city of Helena, in Section 8, T. 14 N., R. 3 W., Montana Meridian. The Missouri River at this point passes through a short and narrow canyon with good rock on both sides and at an average depth of not exceeding 10 ft. below low water level. On the right bank the natural rock slopes upwards at an angle of about 20° from the horizontal. On the left bank the rock rises at first quite precipitously, then forms a bench or shelf, and again rises with about the same slope as on the right bank. The width of the main channel, which embraces all that section of the dam where the foundations extend below the present water level, is about 700 ft., but the total length of the dam at the highest elevation is nearly 1,400 ft.

The bedrock at the site of the dam is of cretaceous formation, including shales and sandstones with a little limestone and quartzite. All of these rocks are regularly stratified; the beds having a general southwesterly dip from 25° to 45°. The prevailing rocks are shale and sandstone, there being but little limestone or quartzite directly on the dam site. This is a massive and practically impervious rock, reasonably hard, and in every way affording a safe foundation for the dam. It is permanent in its nature and not subject to deterioration by solution or otherwise when below the water level. The sandstone is of grayish color, very fine and even grain, and of massive structure. In certain parts it is slaty in appearance and grades off insensibly into the shale; it is perhaps the best rock for foundation purposes. There is also one narrow bend of bituminous shale, carrying narrow seams of coal. This rock is reasonably hard and also affords good foundation material for a dam.

By referring to Fig. 1 it will be noted that the power plant is on the left or west bank of the river. The main generating station is placed parallel with the line of the crest, while the transformer station is at right angles to this line. The dam, power-house and hydraulic works will be of concrete masonry, with embedded rock in the more massive sections. The concrete will be made from river gravel, which is of excellent quality and does not require the addition of either sand or broken stone. The gravel is found in ample quantity in the river bottom near the site. The amount of cement in the concrete will vary in different parts of the work; the surfaces and thin sections having the richest mixtures. The dam will average 130 ft. in height from the foundations to the top of the bulkhead section, and in working condition

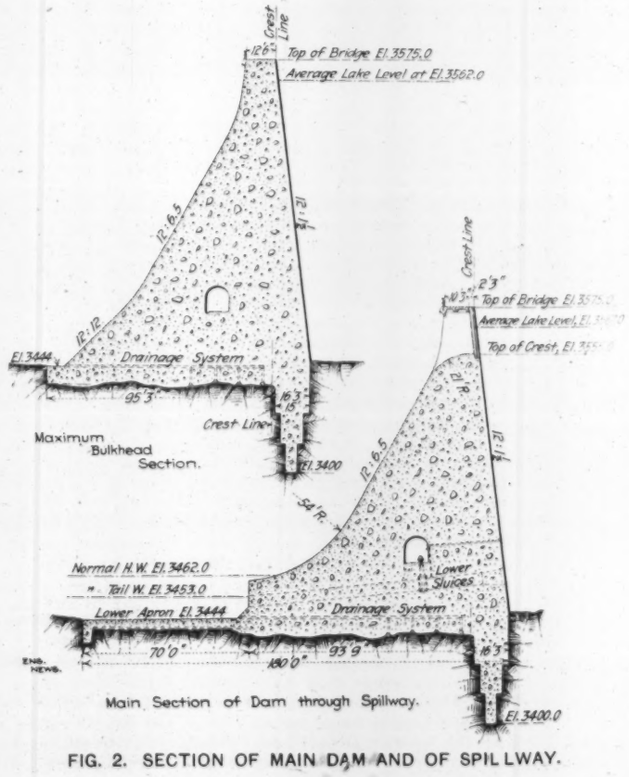


FIG. 2. SECTION OF MAIN DAM AND OF SPILLWAY.

*April 26, 1900, p. 266; Nov. 14, 1907, p. 507.

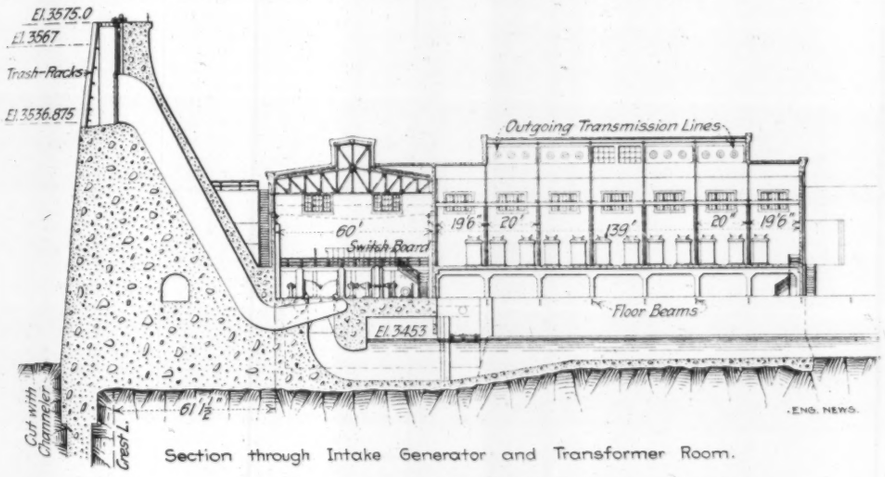
†The Hauserlake dam, a steel gravity dam, collapsed in the spring of 1908 (Eng. News, April 30, 1908), but is now being replaced by a masonry dam.—Ed.

...ill sustain an average head of 114 ft. The ...neral features are clearly shown on the ac...mpanying figures.

In addition to the dam section proper, there ...s been provided on the down-stream side a ...bmerged apron (Fig. 2) of concrete 70 ft. in ...idth and of an average thickness of 5 ft. This ...ron will be built directly on bedrock and will ...e strengthened by anchor bolting and rein...cing, and will be provided with a suitable ...ainage system. The main dam section will be ...ovided with an inspection tunnel and a com...ete drainage system, as indicated on the plans. ...ere will be about 300,000 cu. yds. of masonry ...the entire structure and about 1,500 tons of ...eel.

The crest of the dam will be provided with a ...idge and flashboard system, designed on lines ...f standard practice of the company. This ar...angement permits of raising the level of the ...ake to a maximum elevation at the beginning ...f low water periods, and also permits the lower...ing of the lake level during flood conditions to ...uch a point as to provide ample discharge over the crest, and sufficient fall in the canyon between the dams to prevent interference with the plant higher up the river. This flashboard system has been in use in the Canyon Ferry dam for about 12 years, and its efficiency has been thoroughly proved. The arrangement consists essentially of a permanent bridge supported by concrete bents encasing heavy steel reinforcement, and of a system of steel stanchions supported by the bridge at their upper end and from the dam at the lower end; these stanchions in turn support the flashboards, which are removable planks manipulated either from the bridge or from a floating barge. The flashboards are customarily removed gradually, but provision is made so that in case of necessity the stanchions can be automatically tripped, thus instantly releasing the flashboards and discharging the water for the full height over the crest.

The hydraulic works in connection with the generating plant are designed as part of the main dam structure. There will be seven main hydraulic units and three exciter units; each main unit has its own penstock, which will be embedded in concrete masonry and provided with a suitable opening at the upper end, this opening being controlled by a massive steel gate provided with Stoney rollers, and operated by means of an electrically-driven head gate machine. Each penstock entrance will be an independent section formed in the concrete and so designed that it can be closed off with a floating gate or with stop logs for the purpose of inspection or repair of the racks, head gates, guides, etc. The designs provide for the water entering through the trash racks and gates at very low velocity and gradually and uniformly accelerating in the penstock until it reaches the scroll case of the water wheels, at which point it is moving at the proper velocity for producing the most efficient results.



Section through Intake Generator and Transformer Room.

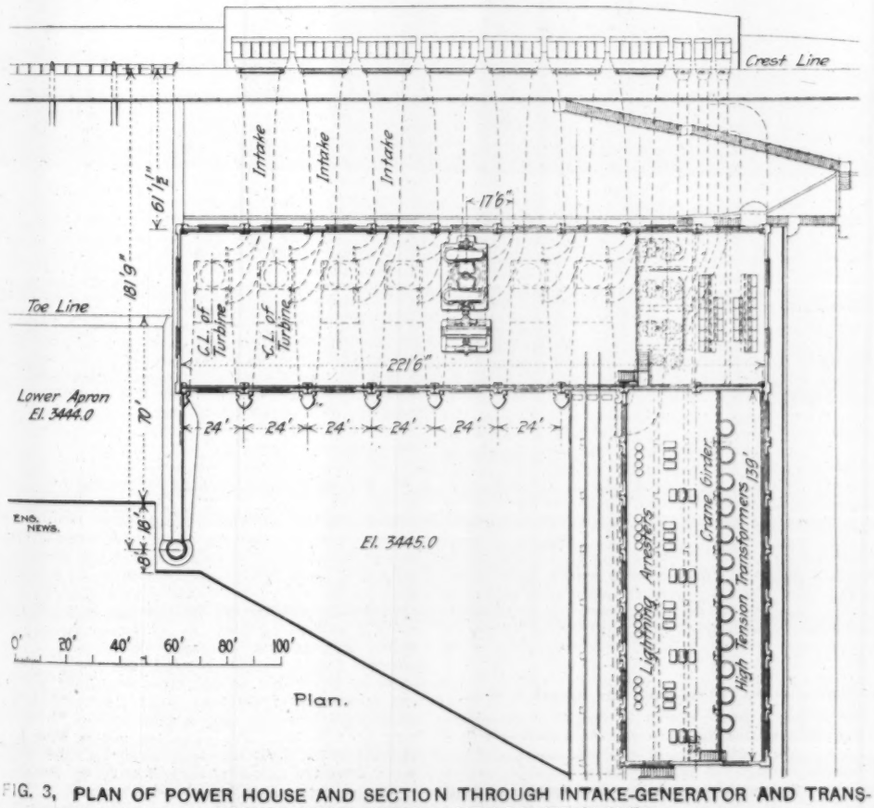


FIG. 3, PLAN OF POWER HOUSE AND SECTION THROUGH INTAKE-GENERATOR AND TRANSFORMER ROOM, CAPITAL CITY POWER PLANT.

The water wheels are under construction by the S. Morgan Smith Co., of York, Pa. Each unit is composed of two runners mounted on a single shaft, each wheel being provided with its individual scroll case and both discharging into a common draft chest placed between the wheels. The governors are of a vertical type and the largest size manufactured by the Lombard Governor Co. They will control the gates through a system of steel links and walking beams. The water wheel gates will be of forged steel with connections all in one piece. The water wheel runners will be of government bronze and the main shafts of nickel steel. Each water wheel unit will develop 8,800 HP. under full gate opening, and will be direct connected with a 5,000 KW., 3-phase alternating-current generator. The generators will produce current at 6,600 volts, which in turn will be transformed to 70,000 volts for transmission purposes. In addition to the main generating units, there will be three exciter units and one auxiliary unit; these machines will be driven by spiral case water wheels direct connected with suitable direct-current electrical generators.

The high-tension transformers and apparatus will be located within the fireproof transformer room. All cables will be carried in tunnels and ducts, expressly designed to prevent trouble from short circuit or from fire. The low-tension switches and busbars will be encased in concrete compartments and will be placed in rooms apart from the high-tension apparatus. All of the electrical equipment is being manufactured by the Westinghouse Electric and Manufacturing Co.

The entire development has been planned and the designs prepared by the engineers of the United Missouri River Power Co.; M. H. Gerry, Jr., Chief Engineer; A. C. Pratt, W. L. Miller, H. Hoyem, Jacob Anthonisen and A. W. Verharen, Assistant Engineers. Mr. W. de la Barre, of Minneapolis, Minn., is Consulting Engineer on the design. The construction is being carried out by the Stone & Webster Engineering Corporation, Boston, Mass.

THE POWERS OF THE OHIO STATE BOARD OF Health to order the construction of water and sewage purification plants will probably be tested in the Supreme Court of that state. The constitutionality of the act giving the State Board of Health its power is being resisted by the city of Greenville, which has been ordered to construct a sewage purification plant. The Board has also experienced opposition to the enforcement of the act from the Akron Water Works Co. The local board of health of Akron complained to the State Board that the water supplied by the company was polluted and unsafe, and on investigation the State Board issued an order to the company to install a satisfactory purification plant or secure a new water-supply satisfactory to the Board on or before Jan. 1, 1912. The order was approved, as required by law to make it effective, by the Governor and the Attorney-General. The water company alleged that it was unable financially to comply with the order. According to press reports, the company has stated that there is an easy way out of complying with such orders, since the only penalty provided for violation of the act is a fine not exceeding $500. This is in striking contrast with the provisions of the act as regards orders issued against municipalities, for, as we understand it, city officials are personally liable for noncompliance with State Board of Health orders to make improvements in water-supply or sewage purification works.

Abstracts of Reports of the American Railway Bridge and Building Association.*

Wire-Glass for Roundhouses, Shops and Stations.

Wire-glass costs about 50% more than plain glass. It is less liable to do damage after being broken, on account of the wire preventing pieces from falling. Plain glass with a wire netting hung underneath (to prevent pieces of broken glass from falling) is not efficient, as the netting may rust away so quickly that its renewal is quite an item of expense.

Large sizes of wire-glass are not economical, because of the additional cost of large sizes, and the additional chance of large sizes being broken. Sizes 24 × 36 ins. in skylights, and 36 × 40 ins. in doors and partitions should be economical.

The gas and smoke from locomotives, because of its influence on the metal framework of trainsheds and skylights of roundhouses, is the primary cause of the breaking of much glass. Contraction and expansion of metal frames is also a serious cause of breakage where glass is tightly fitted to the frames. Glass set horizontally or at an angle breaks more readily than glass set vertically. Wooden bars or frames or sash are preferable to steel, on account of the effect of gases on steel bars; also there is less liability of breakage by expansion and contraction where wood is used. It is not practicable to use wire-glass in roundhouse doors and windows, but it can be used in skylights and monitors of roundhouses, in trainsheds and in roofs of shops, and in station buildings.

Wire-glass windows and partitions in buildings will withstand extreme heat without breaking and falling out, and thus prevent the spreading of fire to some extent. Several fire chiefs from the larger cities have recommended that it be used wherever possible to do so.

Superelevation on Bridges.

Superelevation of the outer rail for curves on bridges may be obtained by one of the following general schemes, or a combination of two or more of them:

(1) By building the masonry bridge seats out of level or by using beveled shoes of different heights under the bridge bearings (making girder or stringer inclined).

(2) By building the stringers or girders supporting the ties so that their tops will be out of level (but with girder or stringer web vertical).

(3) By capping the trestle bents (either pile or frame) out of level or the equivalent of using a tapered cap, a tapered shim on a level cap or by tilting a framed bent on inclined footings.

(4) By tapering the ties.

(5) By shimming under the ties.

(6) By shimming under the high rail.

Of 30 replies received to a large number of circulars sent out, the first five of the above methods received approximately equal numbers of advocates. No. 6 has no supporters.

Ballasted-floor bridges are not here specifically considered. They solve the question of superelevation at once, without special consideration, although for bridges of this class on curves some provision should be made to prevent trackmen or the action of trains from throwing the rails from their exact prescribed position, else there may be trouble from improper clearance.

In the first plan, the girders are inclined from the vertical. Some doubt the advisability of this inclination, on account of the action of the live load; but one thoroughly competent engineer considers that the girders in this position support the loads more conformably to the calculations. It is likely that high speed trains will strain the transverse bracing less, and slow trains more, than if the girders were vertical.

All the plans, except No. 3, apply to metal bridges. It is well agreed that timber bridges of all kinds should have the stringers in a plane parallel to that of the rails. In trestles there is no valid objection against framing the caps to the proper inclination to receive the regular standard straight-line tie. In timber stringer bridges resting on masonry, tapered wall plates should be used.

For metal bridges any of the schemes described will give good service if the fitting of the ties to the bridge and of the bridge to the masonry is perfect, so that no movements will occur.

Fireproof Oil Houses.

At terminal and division points it is necessary to carry in stock a large quantity of illuminating and lubricating oils, and it is important that these should be so stored and handled that they may not be a fire risk in themselves or be liable to become ignited from fires which originate without. It is also important that the oil be kept free from grit and foreign matter, and that the method of handling it be such as to avoid all losses from waste, leakage and evaporation.

The storage should be of sufficient capacity to permit of emptying tank cars or barrels promptly and with as little labor as possible. The delivery of oil should be in charge of the regular storekeeper and be issued on requisition, so that it can be properly accounted for. This method of handling tends greatly to economy in its use. Consequently it is necessary that the oil house shall be near enough to the general store to permit of having the delivery pumps or faucets in the store-room. While it is possible to pump the oil a considerable distance, it is seldom possible to place the oil house at any great distance from other buildings, as the usual layout of terminals provides very cramped space for the necessary buildings.

The building should be of fireproof construction, designed especially for the handling and storage of oil. It should be equipped with facilities for filling cans and barrels for shipment to small stations, and for the unloading of oil received. The storage room should be underground, if possible, and should have concrete walls, floor and ceiling. The second floor and roof shauld be of fireproof construction, but may be of concrete, brick or steel frame, with galvanized iron roof and walls, as may be desired. The fill boxes, pumps and drip pipes should be on this second floor.

The oil should be stored in suitable tanks of such a size as will permit of prompt unloading, whether delivered in tank cars or barrels. This permits cars to be released and barrels or drums to be returned without delay, and greatly reduces the loss from leakage.

The tanks should be dust-proof and should be placed low enough to permit of emptying the oil into them by gravity. If the drainage will not permit of placing the tanks below the ground level, it will generally pay to elevate the receiving track.

The tanks should be made of open-hearth steel with lap riveted seams and well calked. No substitutes for calking, such as red lead paste, paper felt, etc., should be permitted, for in time they will dry or crumble and fall out, leaving a leak. Before the tanks are put to use air pressure should be applied, to make sure that they are tight. Manholes with removable covers should be provided so that the tanks can be inspected or cleaned. Indicators should be provided to show quantity contained, in gallons or otherwise.

The tanks should be equipped with suitable automatic vents to allow air to escape or be drawn in when filling or emptying, and those used for volatile oils, especially gasoline, benzine, naphtha, etc., should have a special vent pipe run to the outside of the building and to a sufficient height to insure against evaporation. This will permit gases to escape in case of excessive heat, thus removing all possibility of explosion.

It is probably best practice to bury tanks containing gasoline, benzine and naphtha, in the ground, or place them in a special vault outside of the regular oil house.

Where tank cars are used, supply pipes should be furnished leading from the cars to the tanks, a separate pipe being used for each kind of oil. These pipes should be permanently connected to the tanks and equipped with flexible connections to attach to cars. These flexible connections should be arranged so that they can be swung out of the way when not in use, and should be equipped with caps or valves to keep dirt and air out when not in use. Steam pipes for heating the oil in the cars may be necessary, and if so, should be provided.

If the terminal point furnishes oil to smaller stations, steel barrels or drums should be used, and separate pumps or faucets should be provided for this service. But the best method of supplying oil to small stations is by a supply car equipped with tanks of sufficient capacity, and by pumping the oil through hose direct to the tanks in the local oil house. This method is in use on several large roads, and they report a large saving from loss by waste and leakage, which is bound to occur in shipping oil in cans or barrels.

For making small deliveries of oil to engines, mechanics, etc., the best method is to use an automatic measuring pump, one having a continuous meter being the best. Several reliable pumps for this purpose are on the market.

For filling barrels or large cans the oil can be handled by hand or power pumps, or by the use of compressed air. While it has generally been believed that the use of compressed air for handling illuminating oils is objectionable, on account of deterioration caused by moisture in the air, there is a strong opinion on the part of storekeepers and practical men that the use of air does not deteriorate the oil for practical purposes. Several roads use air pressure in some part of the handling of all their oils, and seem convinced that if there is any deterioration it is not to such an extent as to be noticed by the ordinary observer. Air pressure is of particular advantage in handling oil from supply cars, as the air can be taken from the train pipe, and other power is not likely to be available.

Stations and Platforms for Small Towns.

Where but a small amount of freight or passengers are handled a combination freight and passenger station should be used. The platform should be less than 12 ins. above the rail and not less than 10 ft. nor more than 16 ft. wide. The length should be governed by the maximum length of train scheduled to stop at that town. A small platform on level with a car floor may be desirable, inside, or at the end of the freight room, but should not be near enough the track to endanger passengers or employees.

The station should, wherever practicable, be placed on the side of the track nearest the town. When (as is usually the case) the station is located near a street that crosses the track, it should be located so far from such street that the local passenger trains scheduled to stop do not obstruct the street. At stations where such street or highway exists, the waiting-room end of the station should be toward the street or road and the freight room at the far end. This will overcome, in a large measure, the danger of passengers walking or stumbling over freight left lying on the platform at or near the freight room.

For stations where but a small amount of freight is handled, a house track back of the station is not desirable. Where, however, a large amount of freight is received, as is occasionally the case in small towns and on busy roads, and considerable time would be lost by local freight trains getting out of the way of other trains, such a track is desirable. With such an arrangement merchandise freight received in large quantities may be unloaded by the station or other forces into the freight rooms, and local freight train crews may be unloading while waiting for through trains to pass.

Elevators, coal bins, cotton and broom corn platforms, stock pens and such structures may then advantageously be located along the side track, but far enough from the station or other important buildings as not to endanger them should they take fire.

Ordinarily the section hand car and tool house should be placed next to the main track and outside the side-track limits. Much time is frequently lost by section workmen being prevented from leaving their tool houses by trains standing on the main or side track within the side-track limits.

Coal bins, coal boxes, privies or other out-buildings must be located to suit the general conditions of the town, climate and surroundings. In northern climates it is probably best to store the coal in a bin partitioned off in the freight room. If this is not practicable, an outside building or covered box may be used.

The arrangements herein recommended are intended to cover usual conditions existing in small country towns along single and double-track roads. Where roads have three or four main tracks, conditions are entirely changed and the suggested layout is not applicable. On such roads, each station presents its own problems and must be considered individually.

A station platform may be built of locomotive or ash-pan cinders, in a manner that is serviceable, neat in appearance and on a scale of cost that is appropriate for buildings of cheap or moderate construction. On railways cinders are to be had cheaply, because of the necessity of promptly removing them from the ash pits and getting them out of the way. As this must be done whether the material is utilized or not, the expense for loading and transportation are usually not charged against new construction.

Cinders soon pack down hard and make a good surface to walk upon, and one that will keep dry under foot. By the use of a curbing next to the track, the cinders can be retained at the desired grade. On some of the roads or at stations where cheap construction is suitable such curbing is made by using old sway braces, with split pile butts for stakes. To provide a smooth surface for trucking to and from the trains, old bridge stringers are laid flush with the top of cinder surface, in two lines parallel with the track, and at the proper distance therefrom to permit loaded trucks to be pulled alongside the trains.

*Reports presented at the 20th annual convention, held at Denver, Colo., Oct. 18-20, 1910.

A FLIGHT FROM PARIS TO LONDON in the Clement-Bayard dirigible balloon was made with a crew of six on Oct. 16. The start was Compiegne, near Paris, at 7.15 a. m., and the course was over Amiens, Abbeville, Boulogne, Folkestone, Tonbridge and Seven Oaks to London. The arrival at the latter place was at 1.15 p. m. After circling over the city a few times landing was made near Hyde Park.

A TRANSATLANTIC BALLOON FLIGHT was attempted by Walter Wellman in the dirigible balloon "America," the start being made from Atlantic City on Oct. 15 in light westerly winds. The supporting bag was cigar-shaped, 228 ft. long, 52 ft. in diameter (maximum) and had a lifting capacity of 12 tons. Suspended from the bag was a platform with canvas sides and forming the living quarters and engine room. Under this was slung a lifeboat carrying the wireless apparatus with which communication was kept with vessels near the airship's course. Hanging below the lifeboat was a series of linked and trailing tanks containing gasolene and forming what has been called the "equilibrator." There were three gasolene engines, one of which was used as a donkey. The propelling motors were rated at about 90 HP. each. It was expected that either engine would drive the balloon at a speed of 20 mi. per hr. in a calm or both would drive at 26 mi. per hr.

The "America" was reported by wireless for about a day and a half and then communication was broken off

two days. On Oct. 18 the steamer "Trent," running from Bermuda to New York, reported by wireless telegraph that it had rescued the entire Wellman party 400 miles east of Cape Hatteras. It appears that northwesterly winds had been encountered which blew the "America" from her projected course and an attempt was made to get to Bermuda, far to the south. The "equilibrator," however,, in jumping from wave to wave racked the airship so that it began to leak seriously and as the "Trent" was sighted it became necessary to take to the lifeboat. The abandoned "America," relieved of its load, rose and was blown out of sight.

TEN BALLOONS, entered in the fifth international balloon race for the James Gordon Bennett cup and other prizes, sailed from St. Louis on Oct. 17. The balloons and crews were as follows, given in order of starting: "Condor," of France, piloted by Jacques Faure and E. G. Schmolck; "Million Club," of the United States, piloted by S. L. Von Phul and Joseph O'Reilly; "Azurea," of Switzerland, piloted by Capt. Emil Messner and Leon Givaudan; "Harburg III.," of Germany, piloted by Lieut. Leopold Vogt and W. F. Assman; "Isle de France," of France, piloted by A. Le Blanc and W. de Munm; "St. Louis III.," of the United States, piloted by H. E. Honeywell and S. W. Tolland; "Helvetia," of Switzerland, piloted by Col. Theo. Schaeick and Paul Ambruster; "Dusseldorf II.," of Germany, piloted by Lieut. Hans Gericke and S. F. Perkins; "America II.," of the United States, piloted by A. R. Hawley and August Post; "Germania," of Germany, piloted by Capt. Hugo von Abercron and August Blanckerts. At the end of the first day two were reported as landed, the "Million Club" six miles north of Racine, Wis., and the "St. Louis" near Hillman, Mich.

A FALL OF ROCK at the west portal of the Bergen Hill tunnel of the Erie R. R., which on Sept. 11 killed 12 workmen, as reported in Eng. News, Sept. 15, 1910, p. 295, has been under investigation by a coroner's jury, which has brought in a verdict fixing the blame for the accident on the railroad company. This jury decided that proper methods of protection to safeguard the lives of the workmen had not been taken. It is not known at present to what extent this verdict will be taken up by the legal authorities of the state.

THE PANAMA CANAL EXCAVATION for September reached a total of 2,687,088 cu. yds., a daily average of 107,484 cu. yds. for the 25 working days. During the month there were laid 149,977 cu. yds. of concrete, and 697,495 cu. yds. of fill were placed in the dams. The rainfall for September was 12.03 ins., about ½-in. greater than the previous month.

THE McCALL FERRY POWER PLANT on the Susquehanna River, some 20 miles above its mouth at Havre-de-Grace, was officially opened on Oct. 14. This large hydro-electric plant, as described in some detail in our issue of Sept. 12, 1907, p. 267, is to develop a total of 135,000 HP. by damming the Susquehanna at this point some 2,700 ft. wide, with a 53-ft. dam. Power is to be supplied to Baltimore, Philadelphia, Harrisburg, Wilmington, York, Lancaster and other centers, all of which are within a radius of 70 miles from the plant.

A WIRELESS-TELEGRAPHY RECORD for distance of communication is now claimed by the Marconi Company. It is announced that Mr. Marconi, in Argentine Republic, South America, has received messages from Glace Bay, Nova Scotia, and Clifden, Ireland, distances of approximately 5,600 miles.

AN AEROPLANE FLIGHT FROM CHICAGO TO NEW York was attempted on Oct. 9 by Eugene Ely with a Curtiss biplane flyer. On the first day he made 11 miles when he had to come down because of carburetor troubles. He made several attempts to continue the flight but continued to have trouble and finally abandoned the project at South Chicago, 21 miles from the starting place. Eight contestants were originally entered in the race but the number dwindled to three, and two of these made nominal starts only.

IN A DERAILMENT AT A SMALL BRIDGE on the St. Louis & San Francisco R. R. between Talihina and Compton, Okla., Oct. 13, 42 passengers were injured. The train was running about 30 mi. per hour when the tender left the track and displaced the rails on the bridge causing the derailment of the chair car.

A BUTTING COLLISION between a work train and a freight on the Grand Rapids & Indiana Ry. at Summit, Ind., Oct. 14, killed six men of the construction gang on the work train and injured a number of others.

THE PEORIA ELECTROLYSIS SUIT, brought many years ago by the Peoria Water Co. against the local street railway company, has at last reached the point where an opinion has been filed by Judge Sanborne, of the U. S. Circuit Court. The decree will not be issued until arguments on the opinion have been heard. It is understood that Judge Sanborne holds that street railway companies must not permit stray electric currents to injure water mains, but that the water company must cooperate with the street railway company in preventing such injury. Mr. Dabney H. Maury, M. Am. Soc. C. E., is Chief Engineer of the Peoria Water Co.

VICTIMS OF THE WELLINGTON MINE ACCIDENT, which occurred at Whitehaven, England, May 12, 1910, numbered 136. On Oct. 4 the bodies of 87 of these men had been recovered, and although badly decomposed, 62 of them were identified. The mine was sealed May 13 to extinguish the fire caused by the explosion and was only recently reopened. A brief account of the accident was published in Eng. News, May 19, 1910.

LOSS OF LIFE IN THE FOREST FIRES in northern Minnesota Oct. 8-9 appears to have been grossly exaggerated in the earlier reports. The Duluth, Minn., "Herald" of Oct. 13 states that the total number of known dead is only 29, instead of 300 as previously reported.

THE FRENCH STEAMER "VILLE DE ROCHEFORT" was sunk Oct. 14 off Noirmoutier Island on the French coast by a collision with the British steamer "Peveril." The "Ville de Rochefort" was bound for Bordeaux. Twenty-three of her crew were drowned.

A HURRICANE IN CUBA accompanied by heavy rainfall Oct. 13-17 was most destructive to the provinces of Matanzas, Pinar del Rio and Havana. Many millions of dollars damage was done in the city of Havana and to crops of plantains, sugar and tobacco. The destruction of the custom house sheds filled with perishable goods at Havana caused probably the greatest single loss. In addition, a number of loaded lighters were sunk in the harbor and about a square mile of the city's residential section near the Malecon sea wall was submerged. In the section bounded by the Malecon, the Prado and the boulevards Calzada de Gallano and Animas, according to reports, the water was several feet deep. The wind drove the waves clear over the Malecon wall and, according to press despatches, made a breach through it. Besides Havana, the high waves flooded Vedado, a suburb.

Reports of Oct. 17 from Key West, Fla., stated that the wind had then attained a velocity of 80 mi. per hr. at that place and that some damage had already been done by the rising waves. Reports of Oct. 18, received via Havana, state that the wind velocity reached 90 mi. per hr. on the afternoon of the 17th., at which time the anemometer was wrecked. The South Beach section and western part of the city suffered the heaviest damage. Many buildings were partially wrecked by wind and waves. At St. Augustine, the business section is reported to have been flooded by water which was driven over the sea wall. The electric power plant was obliged to shut down. Wind velocities of 50 mi. per hr. at Savannah, Ga., and 70 mi. per hr. at Jacksonville, Fla., were reported Oct. 18.

Personals.

Mr. Charles K. Mohler has opened an office as a consulting engineer at 1839 McCormick Bldg., Chicago, Ill.

Mr. E. L. Burdick has been made Assistant Engineer of Tests at Topeka, Kan., for the Atchison, Topeka & Santa Fe Ry.

Mr. J. Beaumont has been appointed Signal Engineer of the Chicago Great Western Ry., succeeding Mr. W. H. Fenley, who has resigned to enter other business.

Mr. S. D. Sarason, Assistant, U. S. Coast and Geodetic Survey, has resigned to accept a position as Instructor in Civil Engineering at Syracuse University, Syracuse, N. Y.

Mr. I. C. Hess, formerly employed on the construction of the Western Pacific Ry., has opened an office in Oroville, Cal., as a civil engineer. Mr. Hess is a graduate of Baltimore Polytechnic Institute in the class of 1901.

Major W. W. Harts, M. Am. Soc. C. E., of the U. S. Engineer Corps, has been awarded a Telford Gold Medal by the Institution of Civil Engineers of Great Britain for a paper submitted to that society and published in their Transactions for 1909-10.

Mr. R. W. Sorenson, Assoc. Am. Inst. E. E., for several years with the General Electric Co. on experimental work and designing of large power transformers, has been placed at the head of the Department of Electrical Engineering at Throop Polytechnic Institute, Pasadena, Cal.

Mr. P. T. Kearny, Assoc. Am. Inst. E. E., formerly Assistant Electrical Engineer of the New York, New Haven & Hartford R. R. at New Haven, Conn., has been appointed Engineer-in-Charge of electric traction on the New York, Westchester & Boston Ry., at Mount Vernon, N. Y.

Mr. L. V. Branch, Assoc. M. Am. Soc. C. E., formerly Engineer, U. S. Reclamation Service, on the North Platte (Pathfinder) Project in Wyoming, has accepted a position as Division Engineer with the Porto Rico Irrigation Service. Mr. Branch has been more than eight years with the Reclamation Service.

Mr. Charles S. Mellen, President of the New York, New Haven & Hartford R. R., has been elected the permanent head of the Boston & Maine R. R., which is now a subsidiary company in the New Haven system. Mr. Lucius Tuttle, former President, has been made Chairman of the Board of Directors of the Boston & Maine R. R.

Mr. F. S. Stevens, M. Am. Soc. C. E., formerly Superintendent of the Wilmington & Columbia Division of the Philadelphia & Reading Ry., has been made Engineer of Maintenance-of-Way, succeeding Mr. C. H. Ewing, who has been appointed Superintendent of the Atlantic City R. R. Mr. F. M. Falck succeeds Mr. Stevens as Superintendent of the Wilmington & Columbia Division.

Lieutenant George R. Goethals, Corps of Engineers, U. S. A., was married Oct. 11 to Miss Priscilla J. Howes, of Watertown, N. Y., at Trinity Church in that city. Lieutenant Goethals is at present assigned to duty in the Canal Zone, Panama. He is the son of Col. George W. Goethals, Engineer Corps, Chief Engineer of the Isthmian Canal Commission, who was present at the wedding.

Mr. David A. Hartwell, City Engineer of Fitchburg, Mass., for the past 20 years, has resigned to become Chief Engineer to the Sewage Disposal Commission of that city. Under this Commission Mr. Hartwell will have charge of the planning and construction of an intercepting sewer about six miles long, a disposal or purification works and the changing of the present sewer system of 40 miles from a combined to a separate system.

H. F. J. Porter, M. Am. Soc. M. E., of 1 Madison Ave., New York City, has been selected by the heirs of the late Charles T. Porter, Hon. Mem. of the Society, to examine the professional papers left by Mr. Porter relating to the development of the high-speed steam engine. The later years of Mr. Charles T. Porter's life, after he had retired from business and from professional practice, were devoted to studies and investigations relative to the development of high-speed reciprocating engines. He took out some patents, read several papers before the American Society of Mechanical Engineers, and performed a large amount of investigation in connection with his proposed inventions. The feebleness of advancing years, however, made it impossible for him to complete this work, and the development of the steam turbine prevented its being taken up commercially. The whole matter has therefore been turned over to Mr. H. F. J. Porter to investigate and determine whether the work which the venerable engineer did in his later years is of sufficient value to justify its further prosecution and commercial application.

Obituary.

Frank Clemons Englesing, until recently Assistant Chief Engineer of the Madeira-Mamore Ry. in Brazil, died at his home in Port Gibson, Miss., Oct. 12, at the age of 51 years. He was graduated from Virginia Military Institute in 1878. Mr. Englesing had been in railway work for many years in various parts of this country and Mexico, in Cuba and the West Indies and most recently in South America.

W. W. Peabody, formerly Vice-President and General Manager of the Baltimore & Ohio Southwestern Ry., died in Cincinnati, Ohio, on Oct. 14. He entered the railway service in 1852 when 16 years old. Starting in the engineering department, he passed through nearly every office in the operating department to that of President and General Manager of the Marietta & Cincinnati R. R. in 1877. After that time he served as an executive officer in the various consolidated roads.

James Archbald, a consulting engineer of Scranton, Pa., died on Oct. 6 in Venice, Italy, where he had gone to benefit his health. Mr. Archbald was born at Sand Lake, N. Y., on Feb. 13, 1838. He began his railway work in 1860 as an assistant engineer on the Delaware, Lackawanna & Western R. R. He saw active service during the Civil War and from 1870 to 1883 he was Chief Engineer of the same road. Since 1883 he had carried on a consulting practice in Scranton. Mr. Archbald had been a member of the American Society of Civil Engineers since 1872, and was a member of the Committee on the Proper Relation to Each Other of Sections of Railway Wheels and Rails in 1888-89.

Warren G. Purdy, former President of the Chicago, Rock Island & Pacific Ry., died Oct. 13, at his Chicago home. Mr. Purdy was born in Baltimore, Md., on May 20, 1843. Sixteen years later he began his railway career as a clerk in the office of the Illinois Central R. R. He filled various clerical positions until 1867 when he became bookkeeper in the cashier's office of the Chicago, Rock Island & Pacific Ry. From this position he rose steadily through the offices of Cashier, Local Treasurer,

Secretary and Treasurer, Second Vice-President, First Vice-President and in 1898 President. He resigned in 1901 on account of failing health. It is said of Mr. Purdy that in his whole service with the Chicago, Rock Island & Pacific, he had allowed himself but three months' vacation.

Edwin Peleg Dawley, an eminent civil engineer of Providence, R. I., died Oct. 7, after a brief illness. Mr. Dawley, the son of Peleg and Lucy L. Barney Dawley, was born at Providence, R. I., Oct. 1, 1853. He received his education in the public schools and at Brown University in that city, being a member of the class of 1874. He began his professional career in the Engineering Department of the city of Providence.

In 1879 he accepted the position of Engineer and Superintendent of the Interstate Telephone Company, having charge of the construction of its long distance line between Boston and Providence. His work and ability brought him in contact with and claimed the attention of the officials of the New York, Providence & Boston Railroad, who offered him a position in its Engineering Department. He was appointed Assistant to the Chief Engineer in 1882, and subsequently on the death of the head of the department, was advanced to that office. Early in his railroad experience Mr. Dawley showed marked engineering ability in the solution of the many problems involved in the extensive improvements and developments which were undertaken by the railroad company in the next decade, notably the improvements of roadbed and strengthening of bridges for the constantly increasing and heavier traffic, the abolition of grade crossings, the four tracking of the road from Pawtucket to Providence, and the improvement of passenger and freight terminal facilities at Providence. In 1892 the N. Y., P. & B. R. R. passed to the control of the New York, New Haven & Hartford R. R. by whom Mr. Dawley was retained as Division Engineer. In 1903 he was made Assistant Chief Engineer, and in 1905 Engineer of Construction with offices at Boston and Providence.

On April 1, 1909, he resigned his position with the railroad company after 27 years of the most active service and opened an office in the Banigan Building, Providence, as a consulting engineer, and was engaged in successful practice.

Mr. Dawley was a member of the American Society of Civil Engineers and the Boston Society of Civil Engineers, and a man of genial disposition and high ideals. He is survived by a widow, two sons and a daughter.

Engineering Societies.

COMING MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS
Oct. 21-Nov. 15. Canal Zone meeting. Secy., R. W. Raymond, 29 West 99th st., New York City.

ILLUMINATING ENGINEERING SOCIETY.
Oct. 24. Annual convention at Baltimore, Md. Secy., P. S. Miller, 29 West 39th St., New York City.

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.
Nov. 15. Annual meeting at Washington, D. C. Secy., Wm. H. Connelly, Interstate Commerce Commission, Washington, D. C.

AMERICAN RAILWAY ASSOCIATION.
Nov. 16. Semi-annual meeting at St. Louis, Mo. Secy., W. F. Allen, 24 Park Pl., New York City.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 17-18. Annual meeting at New York City. Secy., W. J. Baxter, 29 West 39th St., New York City.

NATIONAL SOCIETY FOR THE PROMOTION OF INDUSTRIAL EDUCATION
Nov. 17-19. Annual convention at Boston, Mass. Secy., James C. Monaghan, 20 West 44th St., New York City.

NEW JERSEY SANITARY ASSOCIATION.
Dec. 2-3. Annual meeting at Lakewood, N. J. Secy., J. A. Exton, 75 Beech St., Arlington, N. J.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Dec. 5-6. Annual meeting at New York City. Secy., W. H. Ross, 154 Nassau St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 6-9. Annual meeting at New York City. Secy., C. W. Rice, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Dec. 7-9. Annual meeting at New York City. Secy., J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS.
Dec. 12-14. Annual convention at New York City. Secy., Percy H. Wilson, Land Title Bldg., Philadelphia, Pa.

NATIONAL ASSOCIATION OF CEMENT USERS.
Dec. 12-23. Annual convention at New York City. President, Richard L. Humphrey, Harrison Bldg., Philadelphia.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Dec. 27. Annual meeting at St. Paul, Minn. Secy., L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Dec. 27-28. Annual meeting at Lafayette, Ind. Secy., E. W. Hamilton, Iowa State College, Ames, Iowa.

AMERICAN MINING CONGRESS.—At the 13th annual meeting, held in Los Angeles, Sept. 28 to Oct. 1, officers were elected as follows: President, John Dern, of Utah; Secretary, James F. Calbreath, Jr., Denver, Colo.

STEVENS ENGINEERING SOCIETY.—This society of the students and faculty of Stevens Institute, Hoboken, N. J., and an affiliated branch of the American Society of Mechanical Engineers has announced the following course of lectures to be given at the Institute by prominent engineers. All alumni, undergraduates and friends have been invited.

Oct. 18, President A. C. Humphreys, "Membership in Engineering Societies"; Nov. 1, Mr. I. E. Moultrop, "The Design and Construction of a Central Power Station"; Nov. 15, Dr. J. P. Haney, "Art and the Engineer"; Mr. D. B. Macmillan, "With Peary in the Arctic"; Nov. 29, Dr. H. W. Wiley, "Services of Chemistry in Promoting Public Welfare"; Dec. 6, Dr. R. W. Raymond, "The Story of An Island"; Dec. 20, Dr. D. T. Day, "The Origin of Petroleum"; Jan. 10, 1911, Dr. Gardner F. Williams, "The Kimberly Diamond Mines"; Jan. 16, Dr. James Douglas, "The Development of The Railroad on The North American Continent"; Feb. 7, Mr. J. A. Bensel, "The Catskill Water-Supply Project"; Feb. 14, Mr. Carl Hering, "The Electric Furnace"; Feb. 20, Mr. F. H. Newell, "Reclamation"; March 7, Dr. Wm. Campbell, "Metallography as Applied to Engineering"; March 21, Dr. A. S. Mackenzie, "Radioactive Phenomena"; April 4, Mr. G. E. Hulse, "Illuminating Engineering."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—A meeting was held under the auspices of this society in the United Engineering Societies Building, New York City, on Monday, Oct. 17, which was announced as a "public engineering meeting" to discuss the rapid transit situation in New York City. The society had been careful to state that the proceedings were not to be considered as official in any sense. The meeting was exactly similar, however, to a regular meeting of the society. A paper was presented by Mr. Frank J. Sprague under the title "The New York Subway Situation." The author abstracted his paper in extenso, following which four or five invited speakers were called upon for discussion. This carried the proceedings to such a late hour as to preclude voluntary discussion.

Mr. Sprague's paper was essentially a severe condemnation of the plans elaborated by the Public Service Commission of the First District for a new subway system (the Triborough). Bids on this system are to be received Oct. 20 and Oct. 27. Mr. Sprague believes that no satisfactory bid will be received. Premising that he holds "no brief for the Interborough Company," he made a lengthy review of the development of the subway situation in New York City since 1904, when the present subway was opened for traffic, and dwelt particularly on the various proposals made by the present operating company (Interborough Rapid Transit Co.) for building extensions. These proposals, which were coupled with and contingent on requests for a permit to build additional tracks on the elevated railways and to sell the Steinway Tunnel to the city (both the elevated railways and the Steinway Tunnel are owned or leased by the company), have in each case been rejected by the Public Service Commission, although at the present time a new proposition of the same sort is being considered favorably by the Commission. Mr. Sprague condemned the Triborough system partly because it is not suited to a consolidation with the Interborough subway system, and because it competes with it in a measure; also because it does not pass the new Pennsylvania Station or tap the lower west side of Manhattan. He strongly opposed also the larger size of cross-section provided for in the Triborough designs as compared with the Interborough subway, apparently taking the view that anything larger than the cross-section of the Interborough subway is useless because cars should be operated jointly over both systems. He also objected to a provision for separation walls between the several tracks in the Triborough. He expressed the opinion that "the Triborough system is mistakenly conceived and unwisely promoted" and its execution would result in "far-reaching disaster." In its place he proposed a system very closely identical with that which the Interborough Rapid Transit Co. has contended for during several years; he claimed as one of its strong points that this system would attract the Interborough Co. as a bidder for either separate or joint operation.

Mr. William J. Wilgus, in discussing the paper, like Mr. Sprague, disavowed all connection with the Interborough company. He agreed with all the criticisms made, and suggested in place of the Triborough system a system much like that suggested by Mr. Sprague. He criticized in particular the large cross-section of the Triborough subway, and claimed that, though intended to be large enough for standard railway cars, it really is several inches smaller than the standard clearance diagram of the New York Central. Mr. L. B. Stillwell, who followed in discussion, also opposed the route, cross-section and separation of tracks of the Triborough. He further argued that there should be an advisory engineering commission on the transit problem in New York City. Mr. W. S. Murray departed from the precedent set by the preceding speakers, and endorsed the large cross-section adopted for the Triborough. R. W. Dowling and Mr. T. K. Thomson also spoke briefly in discussion.

About 120 members and guests have secured reservations for the trip to the Canal Zone and will sail from New York on the "Prinz August Wilhelm," of the Hamburg-American line, at 10 a. m., Oct. 21.

The following condensed itinerary has been practically accepted and will be followed as closely as conditions permit:

Itinerary of Steamer Travel.

Leave New York Oct. 21; arrive at Havana Oct. 25.
Leave Havana Oct. 26; arrive at Kingston Oct. 29.
Leave Kingston Oct. 30; arrive at Colon Nov. 1.
Leave Colon Nov. 4; arrive at Port Limon Nov. 6.
Leave Port Limon Nov. 7; arrive at Colon Nov. 8.
Leave Colon Nov. 8; arrive at Kingston Nov. 11.
Leave Kingston Nov. 10; call at Fortune Island Nov. 11; arrive at New York Nov. 15.

Arrangements have been made for shore excursions at Havana, Cuba, and Kingston, Jamaica. The Spanish game of Jai-Alai will be witnessed at Havana and visits will be made to Cabana Fortress, Morro Castle and other points of interest. The opportunity to observe the effects of the recent hurricane will add interest to this part of the trip.

Excursions in the Canal Zone.

Tuesday, Nov. 1.—Train to Gatun Dam. Luncheon. Inspection of Dam and Locks, arriving at Hotel Tivoli in the late afternoon.
Wednesday, Nov. 2.—Trip by train through the Culebra Cut.
Thursday, Nov. 3.—Anniversary of the Independence of the Republic of Panama, observed as a public holiday on the Canal Zone. There will be a popular celebration in the City of Panama, with masquerades, fireworks, bull-fights, etc. No special trip is arranged for this day.
Friday, Nov. 4.—Excursion to the Locks and Dams at Pedro Miguel and Miraflores.
Saturday, Nov. 5.—Excursion by tug to the Pacific entrance of the Canal, the islands in Panama Bay, etc.
Sunday, Nov. 6.—No general excursion is suggested.
Nov. 4-6.—Alternative trip by steamer to Port Limon, thence by rail to San José and return.
Monday, Nov. 7.—Excursion by train over the relocated line of the Panama R. R., now in course of construction.
Tuesday, Nov. 8.—Return to the steamer at Colon.

The list of persons who have secured reservations in advance is as follows:

Mr. J. W. Alles, Pittsburg, Pa.; Mrs. E. L. C. Ayres, Bound Brook, N. J.; Mr. and Mrs. W. S. Ayres, Hazleton, Pa.; Mr. and Mrs. George D. Barron, Rye, N. Y.; Miss Dorothy Barron, Rye, N. Y.; Miss Helen Barron, Rye, N. Y.; Mr. W. I. Berryman, Pittsburg, Pa.; Mr. and Mrs. Alexander Broadhead, Catasauqua, Pa.; Mr. Thomas Brown, New York, N. Y.; Mr. David W. Brunton, Denver, Colo.; Mr. Arthur C. Carson, New York, N. Y.; Mr. Josiah H. Clark, New York, N. Y.; Mr. F. L. Clerc, Boulder, Colo.; Mr. and Mrs. Torbet Coryell, Lambertville, N. J.; Mr. W. I. Davidson, Port Richmond, S. I., N. Y.; Col. and Mrs. D. C. Dodge, Denver, Colo.; Mr. J. W. Donnau, Port Richmond, S. I., N. Y.; Dr. and Mrs. Henry S. Drinker, South Bethlehem, Pa.; Mr. W. W. Duffield, Harlan, Ky.; Mr. and Mrs. Howard N. Eavenson, Gary, W. Va.; Miss S. I. Eavenson, Gary, W. Va.; Mr. August H. Eustis, Boston, Mass.; Mr. W. E. C. Eustis, Boston, Mass.; Mr. Charles W. Goodale, Butte, Mont.; Mr. and Mrs. Philip Goodwill, Bramwell, W. Va.; Mr. William Greene, Cleveland, Ohio; Mr. and Mrs. H. W. Hardinge, New York, N. Y.; Miss Hardinge, New York, N. Y.; Mr. Julius W. Hegeler, Danville, Ill.; Mr. Rowland F. Hill, Pulaski, Va.; Mr. Harry C. James, Denver, Colo.; Mr. Hennen Jennings, Washington, D. C.; Mr. and Mrs. William Kelly, Vulcan, Mich.; Prof. William Kent, Montclair, N. J.; Mr. Charles Kirchhoff, New York, N. Y.; Mr. and Mrs. William A. Lathrop, Philadelphia, Pa.; Mr. Frank C. Loring, Toronto, Can.; Mr. A. F. Lucas, Washington, D. C.; Mr. and Mrs. Eugene McAuliffe, Chicago, Ill.; Mr. McKay, Cleveland, Ohio; Mr. J. G. McIlvain, Philadelphia, Pa.; Mr. J. G. McIlvain, Jr., Philadelphia, Pa.; Mr. David G. Miller, Denver, Colo.; Mr. F. P. Miller, Philadelphia, Pa.; Mr. Theodore H. Miller, Poughkeepsie, N. Y.; Mr. D. G. Moore, Elizabeth, N. J.; Mr. Robert V. Norris, Wilkes-Barre, Pa.; Mr. and Mrs. Thomas W. Orbison, Appleton, Wis.; Mr. and Mrs. Walter Page, Omaha, Neb.; Mr. and Mrs. Edward W. Parker, Washington, D. C.; Mr. Henry C. Perkins, New York, N. Y.; Dr. R. W. Raymond, New York, N. Y.; Prof. Joseph W. Richards, South Bethlehem, Pa.; Mr. and Mrs. W. J. Richards, Pottsville, Pa.; Miss Richards, Pottsville, Pa.; Mr. D. M. Riordan, New York, N. Y.; Mr. and Mrs. Thomas Robins, New York, N. Y.; Mr. David B. Rushmore, Schenectady, N. Y.; Mr. and Mrs. C. M. Russell, Massillon, Ohio; Mr. Robert C. Sahlin, South Bethlehem, Pa.; Mr. William L. Saunders, New York, N. Y.; Mr. F. R. Sayen, Philadelphia, Pa.; Mr. F. W. Scarborough, Richmond, Va.; Miss Scarborough, Richmond, Va.; Mr. and Mrs. F. L. Schoew, Bramwell W. Va.; Mr. and Mrs. John M. Sherrerd, Easton, Pa.; Dr. Walter Stewart, Wilkes-Barre, Pa.; Dr. Joseph Struthers, New York, N. Y.; Mr. Samuel A. Taylor, Pittsburg, Pa.; Mr. S. C. Thomas, Jr., Denver, Colo.; Mr. M. Tracy, New York, N. Y.; Mr. A. E. Vaughan, New York, N. Y.; Mr. and Mrs. F. M. Warren, Minneapolis, Minn.; Mr. and Mrs. George H. Warren, Minneapolis, Minn.; Mr. and Mrs. Samuel D. Warriner, Wilkes-Barre, Pa.; Mr. and Mrs. E. L. Watson, Worcester, Mass.; Mr. and Mrs. R. B. Watson, New York, N. Y.; Mr Hugo Weinberger, Wilmington, Del.; Mr. H. A. J. Wilkens, New York, N. Y.; Mr. William Wilkie, Buffalo, N. Y.; Mr. and Mrs. David Williams, New York, N. Y.; Mr. Gardner F. Williams, Washington, D. C.; Mr. Howard Wood, Miss Wood and guest, Conshocken, Pa.; Mr. and Mrs. Thomas D. Wood, Bryn Mawr, Pa.; Mr. Walter Wood, Philadelphia, Pa.

The technical sessions will probably be held on the steamer at sea. The responsible management of the trip is in the hands of Dr. Joseph Struthers, Assistant Secretary of the Institute.